PUBLIC WORKS

An Engineering and Construction Journal

City County State

VOL. 63 MAY, 1932 NO. 5

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Brain Teasers:

Of the total original enrollment in a certain college class, 4 students quit and one-sixth of the remainder flunked in the freshman year; 3 students quit and one-sixth of the remainder flunked in the sophomore year; 2 students quit and one-sixth of the remainder flunked in the junior year; 1 student quit and one-sixth of the remainder flunked in the senior year. How many graduated?

This was contributed by Mr. D. B. Steinman, who can always be relied on to produce a first-class puzzler.

And our own Professor Folwell contributes this one: 1028 pounds of rock cubes, all exactly the same size, and having a specific gravity of 2.72, have a total surface area of one acre. What is the size of the cubes?

The Monkey Problem:

The rope on which the monkey lost track of his age (see last month's problem) is 15 feet long; the ages of the monkey and its mother 1½ and 2½ years, respectively. An abbreviated solution follows: Let x = the monkey's age, and 4—x the mother's age. Then 4—x also equals the weight of the monkey. Let y = the number of years ago when the mother was 3 times as old as the monkey. Then

$$(4-x)-y = 3\ (x-y) \qquad (1)$$

Let z = number of years hence when the monkey will be three times as old as the mother was when the mother was three times as old as the monkey.

$$x + z = 3\ [(4-x)-y] \qquad (2)$$

Let a = number of years ago when the monkey was half as old as the monkey will be when the monkey is three times as old as the monkey's mother was when the monkey's mother was three times as old as the monkey.

$$2\ [(4-x)-a] = x + z \qquad (3)$$

The monkey's mother is twice as old as the monkey was, etc.

$$4-x = 2\ (x-a) \qquad (4)$$

From (1) $2x-y = 2$; from (2) $4x + 3y + z = 12$
From (3) $3x + 2a + z = 8$; from (4) $3x-2a = 4$
Solving $x = 1\frac{1}{2}$ years.

One answer to the problem sent in by Mr. Selligman was 115942. We are thankful that no one sent in a detailed and complete answer to Mr. Eisner's simple little problem, since the answer to this would fill about 150 pages or more if single spaced on the ordinary typewriter.

Yours as ever,
BRAIN TEASERS.

J. T. MORRIS
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PUBLIC WORKS
Founded in 1896
A. PRESCOTT FOLWELL, *Editor*
Published Monthly
at 310 East 45th St., New York, N. Y.
Western Office: 122 South Michigan Ave., Chicago

SUMNER N. HUME
New York, N. Y.
JOSEPH E. O'CONNOR
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AN ENGINEERING AND CONSTRUCTION MONTHLY

Vol. 63 May, 1932 No. 5

Increasing Efficiency of Water Purification at Valparaiso, Indiana

By Charles Brossman, *Consulting Engineer, Indianapolis*

More efficient mixing of chemicals compensates for small capacity of settling basin. New mains and tank, filter bottoms and dry feed machines included in improvements.

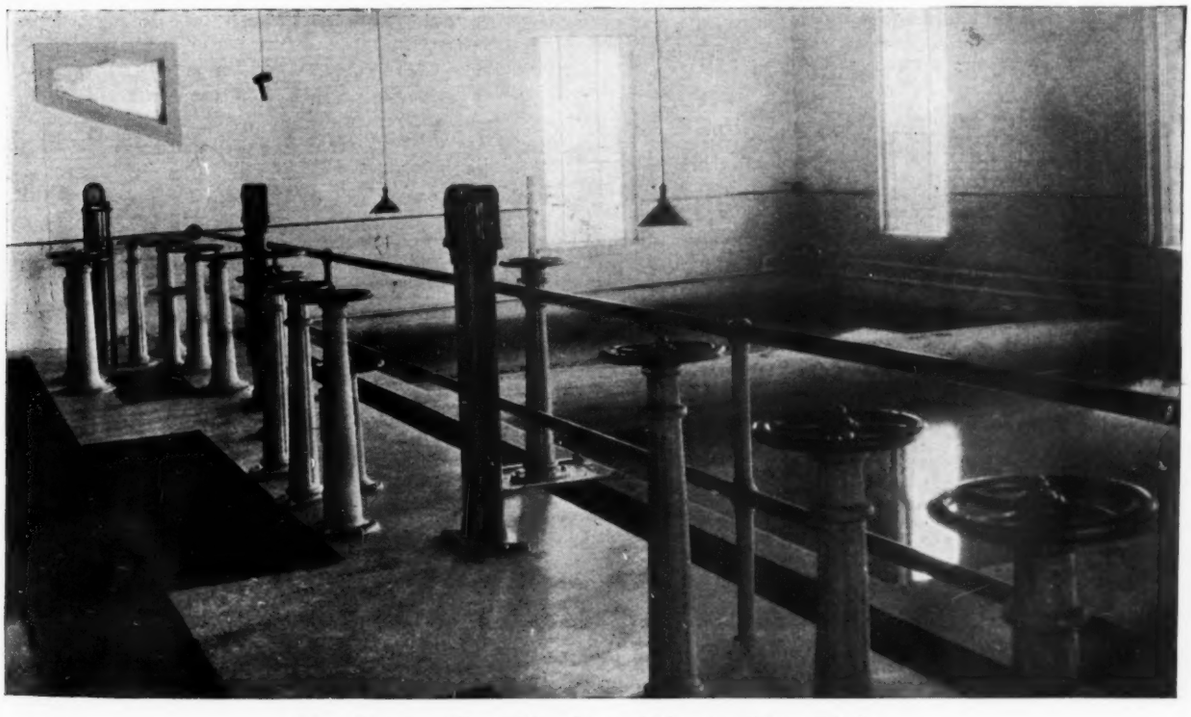
VALPARAISO, Ind., with a population of 10,000, gets its water supply chiefly from the chain of lakes about three and one half miles northwest of the city, Flint and Loomis lakes being the main supply. The lakes are about 30 feet below the high part of Valparaiso, and the main part and business section of the city lies about fifty feet lower. The greatest difference in elevation between the highest and lowest part of the city is about 110 feet.

The city has taken its supply from these lakes since 1885, when the original plant was built by a private company. Several years ago the water company drilled three wells near the pumping station and these are used as an auxiliary supply. The city purchased the plant in 1925.

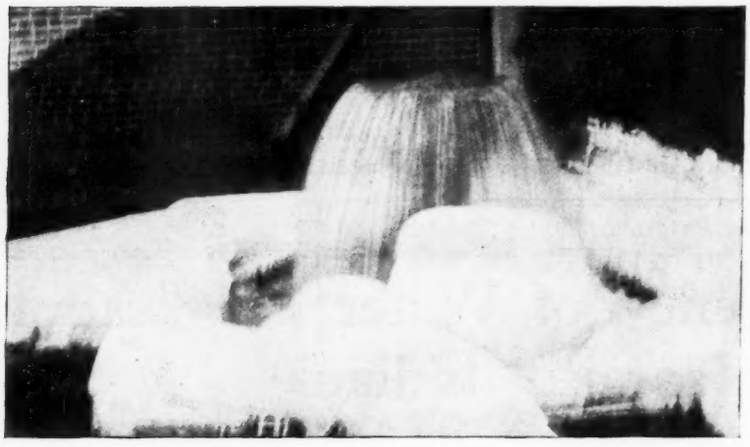
The present intake lines consist of the two original 12 in. diameter wood mains, which extend out into Flint lake about 300 to 400 feet and discharge into a well 10 ft. in diameter in the pumping station. From here the water is lifted by centrifugal pumps to the settling basin and thence flows by gravity through filters and into a clear well. The water is then pumped by a two million gallon Canton-Hughes-Meyer gear pump direct to the city mains.

The filter plant has a settling basin 27 x 24 x 11 which, based on a one million gallon consumption, gives a retention period of one and one quarter hours. The water formerly entered this by overflowing from a 12 in. aerating pipe. The settling basin was not as large as desirable, and it was felt that better aeration and chemical mixing would result in better efficiency in the primary treatment of the water, which would be equivalent to increasing the basin capacity.

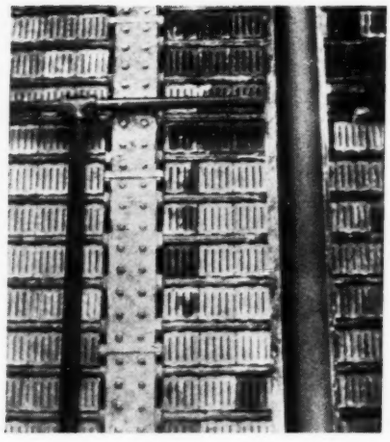
Also, the old filters, which had both water and air wash, gave more or less operating trouble. The filter washing did not give the results that it should.



New Operating Floor, Filter Room, Valparaiso Water Works.



Water overflowing into settling basin from old twelve-inch aerator pipe.



Wagner Blocks Used in New Filter Bottoms.

Some of the pipe sizes were too small, and there was no rate of flow control or other necessary instruments for good operation.

In addition, the concrete work on settling basin and filter plant was in exceedingly bad condition and considerable repair work was necessary around the plant. The matter of water storage and distribution was a problem also, as pressures were low in many parts of the city.

The organization of Charles Brossman, Engineers, of Indianapolis, was employed to draw up plans and specifications for the work of remodeling and extension. To carry out these plans, a contract was let for a new 500,000-gallon elevated water tank and for new cast-iron feeders and reinforcing mains. A complete new feeder 14 in. diameter runs from the tank to the business district, and from this point a new 12 in. main branches off east and west in the business sections, tying in with the old mains. These extensions, in connection with the half-million-gallon elevated tank right at the edge of the city, will greatly improve the pressure and supply conditions. Contract for this work was awarded some time ago, but actual work has not yet been started.

Previous to contracting for the tank and main extensions, contracts were let for improving the filter plant. This consisted of repairs to all concrete work inside and outside of the settling basin and filter plant, complete rebuilding of the three filters, placing new filter bottoms, changes to filter piping, and installing rate of flow control, loss of head gauges, etc.

Complete new filter bottoms were installed, using Wagner blocks and underdrains which permitted increased velocity of wash water.

The filter room itself was greatly improved by a new operating floor, repainting inside of the building, and water-proofing the inside of the filters, after placing new under-drainage system. At the same time, complete new gravel and filter sand beds were installed.

One big improvement was the installation of the aerating outfit to compensate for the small settling basin capacity, as it was not possible to increase the size of the settling basin. A more intimate and efficient chemical mix, it was thought, would rectify this situation and give the equivalent of a larger basin, and the general contract, which was awarded to the International Filter Company, included an Aer-O-Mix furnished by the Vogt Brothers Mfg. Company.

A new Omega dry feed machine was installed which fed alum as a coagulant into the centrifugal pump suction line, the dosed water passing directly to the Aer-O-Mix head, which is arranged to aerate the water and thoroughly mix the chemical at the same time, with a view to reducing odors, saving chemicals and in general compensating for the small size of the settling basin.

The Aer-O-Mix unit has a normal capacity of 1050

Chemical Consumption at Valparaiso, Indiana

	Before Installation of Aer-O-Mix				*After Installation of Aer-O-Mix*			
Period	*Millions Gals.*	*Lbs. Alum*	*Grs. per U. S. Gal.*	*Period*	*Millions Gals.*	*Lbs. Alum*	*Grs. per U. S. Gal.*	*Reduction*
1930				1931				
Apr.	27.44	8300	2.12	Apr.	24.00	4945	1.44	32.1%
May	29.84	8120	1.90	May	27.27	5550	1.42	25.3%
June	31.18	8000	1.80	June	27.52	5660	1.44	20.0%
July	25.88	7900	2.14	July	32.55	5970	1.19	44.4%
Aug.	32.00	7650	1.67	Aug.	31.37	5695	1.27	29.9%
Sept.	27.88	7950	2.00	Sept.	27.48	4980	1.27	36.5%
Oct.	28.00	7900	1.97	Oct.	25.52	4480	1.23	37.6%
Nov.	27.00	7660	1.99	Nov.	23.98	4275	1.25	27.2%
Dec.	26.00	7150	1.93	Dec.	23.64	4018	1.19	38.3%
1931				1932				
Jan.	25.34	7280	2.01	Jan.	23.73	3959	1.17	41.8%
Average or total	280.56	77910	1.94		267.06	49527	1.30	33. %
Average 935,000 G. P. Day.				Average 890,200 G. P. Day.				

Old concrete work which needed repair.

Concrete after having been repaired.

g. p. m. and requires about 6 ft. head to operate—only a little more than was required by the old aerator. It consists of a circular cast-iron container inside of which is a mixing head made up of a great number of very fine brass tubes. These tubes extend above the water level and also down into the body of the downward-flowing water, thereby sucking in air in very finely divided bubbles. This air is intimately mixed with the water, as is the chemical.

The settling basin is operating much more efficiently than before, and the old filter troubles are not now encountered. A saving in wash water has also been noted since the filters have been improved and the Aer-O-Mix installed. In addition to this, when the auxiliary supply from the wells is used, there is a material reduction in the iron content of the well water. A tabulation by Jos. Bradley, filter plant operator and bacteriologist, is given herewith. This shows a ten-month run in 1930 before the changes were made, and a similar time in 1931. The figures indicate a saving of 33%, or about 30,000 pounds of alum per year.

The water works, which were purchased by the city December 31, 1925, are now controlled and operated by a water board, consisting of the mayor, Harold J. Schenck, Charles Ohlfest, E. A. LaCount, W. H. Hardesty and the secretary and superintendent, Alan C. Kamplain; and to the initiative and foresight of these men is due the starting of a long needed program for the improvements described above.

Aer-O-Mix Header Tank and Effluent.

Ammonia-Chlorine and Activated Carbon Treatment of Water

By A. Prescott Folwell
Editor, Public Works

Three years ago less than ten cities in the United States were using the ammonia-chlorine treatment of water, and eighteen months ago the use of activated carbon was equally limited. Today several hundred cities are using each of them or are prepared to do so if taste conditions should arise. Nothing in the history of water purification has even approximated this rapid growth except that of chlorine treatment. Undoubtedly one reason for this is the fact that use of these materials requires little or no change in plant structure and a relatively small investment in equipment, so that even the smallest cities find it possible to adopt the treatment. Because of the comparative newness of these methods, there is still much to be learned concerning both the theory and the most desirable technique of application, and many water works superintendents are not yet familiar with what has been learned. We have endeavored to present in this article a concise statement of the present understanding of the theories of these two treatments, results obtained, and methods and cost of use.

The Ammonia Chlorine Treatment

As the name would indicate, the ammonia-chlorine treatment of water is a modification of the chlorine treatment by use of ammonia. The combination of the ammonia and chlorine in the water forms chloramine compounds, whence the treatment is also called the chloramine treatment. Some of the advantages of chloramines in water treatment have been known for more than thirty years, but only during the past two years has the use of them become at all general. The first use on this continent for a municipal water supply was at Ottawa in 1917. The first in the United States is believed to have been at Greenville, Tenn., where it was introduced by J. W. McAmis, superintendent of water works there, in 1927. By the beginning of 1930 six or eight plants in this country were using it, and there are now probably three hundred or more. (Information furnished to PUBLIC WORKS this year by several hundred cities shows that about 24 per cent of those reporting which use the chlorine treatment, intend to use ammonia with it this year.)

There is no question that some of the advantages claimed for the ammonia-chlorine treatment will be realized in most cases, but there is still much to be learned concerning just when and why it is more effective in some cases than in others, what are the most effective details of treatment under various conditions and with waters having different characteristics, and to what extent other claims for the process are justified. Cleveland, Ohio, began using this process for its supply in November, 1929, and has made a careful study of it. Chicago began extensive research work under John R. Baylis, physical chemist, in September, 1930. Studies have been made by the Beaver Valley Water Company, E. C. Goehring, superintendent of filtration, beginning in March, 1930, and many others have made more or less extensive studies of the subject in their plants. Dr. J. F. T. Berliner, and Arthur E. Howe, chemists of the National Ammonia Co., have been engaged in a thorough investigation of the subject.

Advantages of Ammonia-Chlorine Treatment

Prevention of Tastes. The advantage of this treatment that is probably the most widely appreciated as well as most certain to be realized with all waters, is the prevention of chlorine tastes, both those caused by the presence of phenols and those due to excessive chlorine residuals. Many seem to have found that other tastes also are destroyed; other investigators believe that tastes due to swampy waters are not affected, and some that none are affected which existed prior to the addition of chlorine. Probably it will be found that ammonia-chlorine treatment will destroy all tastes that are destroyed by chlorine alone, and also will prevent the creation of others which result from the combination of chlorine with phenols, organic or other matters in the water being treated.

Bactericidal Action. As a bactericide, chloramine is generally more effective than chlorine alone, its superiority probably increasing with the oxygen demand of the water. With a water carrying no reducible matter, the advantage of the ammonia in effecting sterilization is problematical. This superiority is due chiefly to the fact that little of the chlorine in chloramine is used in oxidizing organic matters in water, therefore practically all of the applied chlorine is available for destroying bacteria. Also, stronger doses can be used when necessary for very polluted waters without causing tastes.

Algae and Slime. It is claimed, also, that this treatment will prevent algae and biologic slime growths in swimming pools, water mains, condensers of industrial plants, slime in the manufacture of rayon, paper and pulp, etc. Here also it is probable that where chlorine will be beneficial, chloramine also will be.

Action of Chloramines

Chloramine is more rapidly soluble in water than chlorine, therefore more readily diffused. It is more stable under almost all conditions, therefore remains active for hours, while chlorine loses most of its effectiveness a few minutes after it has been added

to the water. Neither sunlight nor heat seems to diminish greatly the bactericidal effectiveness of a chloramine solution.

Chlorine is a strong oxidizing agent, and when added to water containing organic matters, it rapidly uses up its effectiveness in oxidizing them rather than on the bacteria. Therefore, when water contains much reducible matter, it is necessary to use large doses of chlorine if sterilization is to be effected. Chloramine, on the other hand, is a very weak oxidizing agent, and practically all of that added to a water is effective for bactericidal action. Moreover, Rideal and others have apparently found that chloramine is several times as effective as a bactericide as is an equivalent amount of chlorine.

Whether or not chloramine acts more slowly than chlorine is one of the points concerning which investigators are not agreed. At Cleveland, Beaver Valley, Chicago and other plants a "lag" of 30 minutes to two hours was found; that is, the maximum intensity of bactericidal action which is obtained in five to fifteen minutes contact with chlorine alone requires 30 minutes to two hours when chloramine is used. Some investigators, however, believe that the lag can be decreased or eliminated by control of the pH or other characteristics of the water.

But any disadvantages due to lag are more than offset by the fact that chloramine remains effective for several hours and continues to operate after entering the distribution system; it has even been known to destroy growths in dead ends of the mains. However, unless the water is retained at the plant until the effect of the chloramine has practically been completed, it is not possible to be certain of the chlorine residual of the water, and it is possible that the water might even reach the consumer before the action is completed.

A considerable advantage of the stability of chloramine and its efficiency in the presence of considerable organic matter is that the chlorine residual retained for a long time after treatment prevents or lessens after-growths.

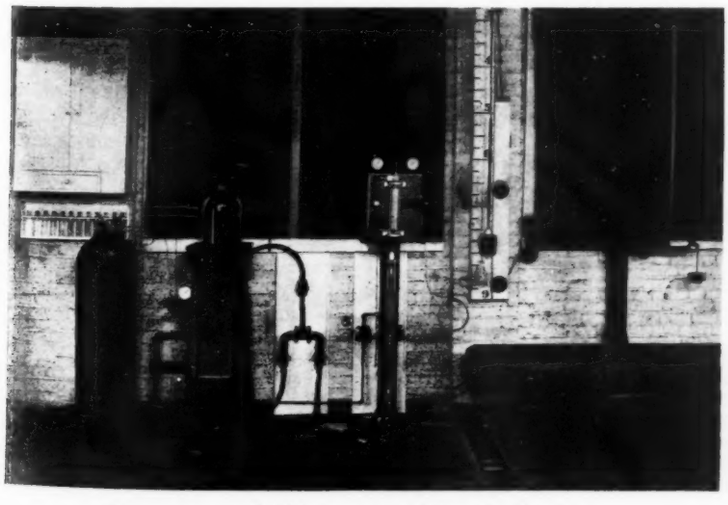
Application of Ammonia and Chlorine

There seems to be general agreement that the ammonia and chlorine should be applied separately, the ammonia first. Should the chlorine be applied first, its rapid action would cause the production, before the ammonia is added, of some of the effects which the ammonia is intended to prevent.

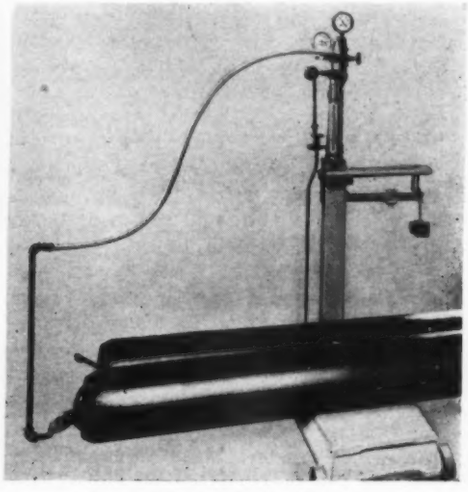
The ammonia should be thoroughly mixed with the water before the chlorine is added. Only a few minutes should intervene, however, for the ammonia alone is rapidly dissipated or absorbed. It is especially desirable not to pass the ammonia-treated water through a filter before the chlorine is added, as 50% or more of the ammonia may be lost in the passage through. It is believed desirable to add both ammonia and chlorine both before and after filtration where both pre- and post-chlorination are practiced.

The ammonia has been introduced both as ammonia gas and as ammonium sulphate, ammonium carbonate, etc. In the former form it is obtained in cylinders containing 150, 100 or 50 pounds, and applied by means of an ammoniator very much as chlorine gas is applied. Cleveland, the largest user, and probably the majority of water plants use it in the liquefied gas form. The earlier Canadian plants used ammonium sulphate, either as a solution or by means of a dry feed machine, and Detroit and Indianapolis also use it in this form. Chicago investigations indicated that "when equivalent amounts of NH_3 from various ammonium compounds such as ammonium chloride, ammonium sulphate, ammonium carbonate, ammonium alum and ammonium hydroxide, were used, there was practically no difference in the amount of residual chlorine remaining after 24 hours contact. For periods of contact greater than this, the results were very inconsistent and require further study before definite conclusions can be arrived at."

The relative amounts of ammonia and chlorine which give the best results is a point concerning which there is little definite knowledge and no general agreement, especially the effect on this of the physical, chemical and biological characteristics of the water. The average rates in use seem to vary from one-third as much ammonia as chlorine, to equal amounts. At present the optimum amount for each plant should be determined by test; and new determinations made when conditions change, as dur-



Ammoniator and Chlorinator—Wallace & Tiernan



Ammoniator—Paradon Co.

ing spring freshets, low water in the river, overturn of the reservoir, etc. Several experimenters have found that both the relative and total amounts desirable vary with the pH value, temperature and turbidity. The Chicago experiments indicated that the less the ammonia the more rapid the bactericidal action, but also the less effective the prevention of chlorine tastes.

The residual chlorine may be determined in the same way as when chlorine alone is used, by use of ortho-tolidine. The color developed for a given concentration of chloramine is identical with that produced by the equivalent amount of chlorine alone. However, when the reagent is added to a water treated with chlorine alone, a yellow color develops immediately and in less than a minute attains its maximum coloration. In the case of water treated with ammonia-chlorine, the addition of the orthotolidine reagent results in a very slow development of color, requiring about fifteen or thirty minutes to attain its maximum depth corresponding with its true evaluation of the color standards. The rate of color development is dependent on the concentration and temperature conditions. In making tests on ammonia-chlorine treated water, it is necessary therefore to allow at least 20 minutes, and preferably somewhat longer, before comparisons with standards are made.

Nitrites react with ortho-tolidine to develop colors comparable to those caused by chlorine. When chlorine alone is used it at once oxidizes the nitrites and prevents this action, but chloramine oxidizes them very slowly and when it is used and nitrites are present, the latter should be oxidized by means of a mild oxidizing agent before applying the ortho-tolidine.

Cost of the Treatment

Cleveland, the largest user of the ammonia-chlorine treatment, compared the cost of this at two filter plants in 1930 with chlorine treatment in 1929 at the same two plants. At the Division plant the cost per million gallons of treated water was 40.7 cents for chloramine treatment and 20.5 cents for chlorine treatment alone. Of this difference of 20.2 cents, 19.4 was cost of ammonia, partially offset by a reduction of 1.8 cents in cost of chlorine; labor cost 1.3 cents additional and maintenance 1.3 cents additional. At the other plant there was a saving of 6.8 cents in chlorine, ammonia cost 14.4 cents, maintenance cost 0.6 cents and labor 1.5 cents more; the total costs being 21.3 cents for chlorine treatment and 31 cents for chloramine.

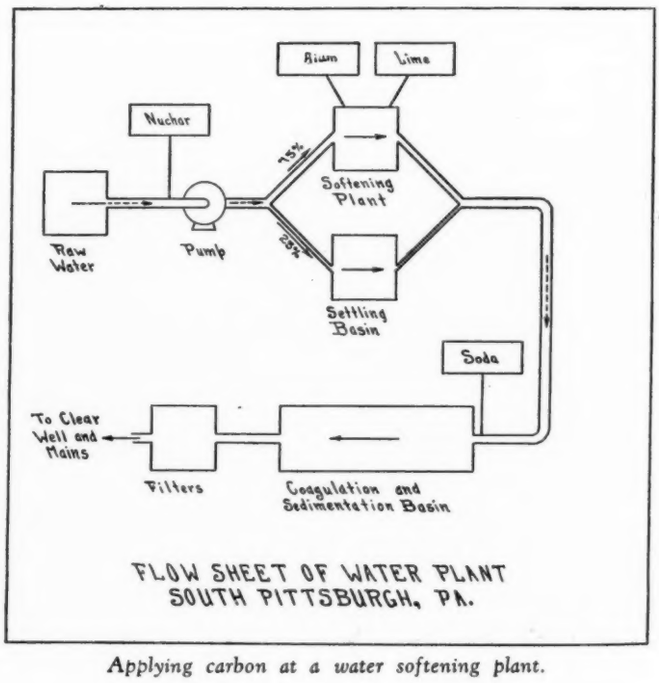
At Tampa, Fla., during four months immediately preceding the use of ammonia, an average of 16 pounds of chlorine per million gallons was used, with an average residual of 0.25 p.p.m. During the next three months ammonia was used at an average rate of 1.9 pounds per million gallons and the chlorine was reduced to 5.6 pounds, in spite of which the residual chlorine increased to an average of 0.38 p.p.m. In the first period the chlorine cost $1.54 per million gallons of water treated; in the second period the chlorine cost 54 cents and the ammonia 40 cents; a total of 94 cents, or a saving of 60 cents per million gallons. No figures were given for labor and maintenance cost. J. E. Lyles, engineer of the water purification plant, reported that the use of ammonia entirely eliminated odors due to chlorine together with large amounts of organic matter in the water, which matter absorbed an average of 14 pounds of the 16 pounds of chlorine applied to the water, which adsorption was reduced to 2.4 pounds when ammonia was added. Also it has prevented aftergrowths in the elevated tanks and reservoir connected to the system.

Activated Carbon Treatment

ACTIVATED carbon applied to water has been found to remove tastes and odors due to asterionella and other algae, to swampy and other vegetable matters, to phenols, to hydrogen sulphide, to chlorine, and other matters in solution. Sludge accumulated by sedimentation, either plain or assisted by coagulation, or in water softening, is stabilized by it and rendered inodorous. This appears to have been demonstrated and to stand undisputed. Other advantages have been claimed by some users, but sufficient time has not elapsed to permit substantiation of them.

Activated carbon is a charcoal so made and treated as to be very many times more effective than ordinary charcoal in withdrawing certain matters from water by adsorption. Charcoal has been used for centuries for purifying water, but the use of activated carbon for potable water supplies is only three or four years old, following investigations begun five or six years ago.

Adsorption is defined as "the adhesion of the molecules of gases or dissolved substances to the surfaces of solid bodies, resulting in a relatively high concentration of the gas or solution at the place of contact." The amount of adsorption possible for a given amount



Applying carbon at a water softening plant.

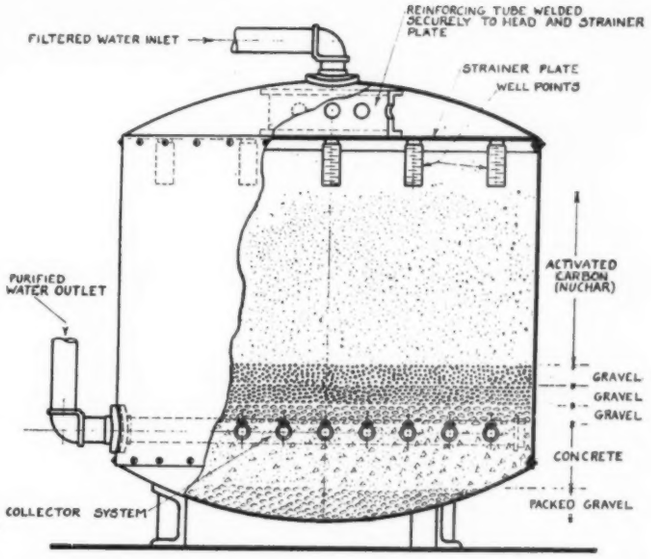
of a given substance varies with the area of surface exposed, including that in all interstices; and the area so exposed by charcoal is very great. However, in ordinary charcoal the surfaces are already largely covered with certain compounds held there in the adsorbed state. In activated carbon the surfaces are free of adsorbed matter, either because the material was carbonized in a manner which prevented the adsorption or because the surfaces have been freed of most or all of the adsorbed matter. Carbon which was active but has been rendered inactive by adsorbing matter from water can be rendered active again by driving off the adsorbed matter.

The activated carbons used in water treatment — "Hydrodarco," "Nuchar," "Norit," "Klearit" and others—are made by carbonizing materials such as lignite (used for Hydrodarco), waste pulp liquors (used for Nuchar), sawdust, wood (birch is used for Norit) and similar materials in carbonizing retorts in which the temperature and atmospheric conditions are controlled, the carbon so formed being activated by using air or steam for removing the adsorbed hydro-carbons.

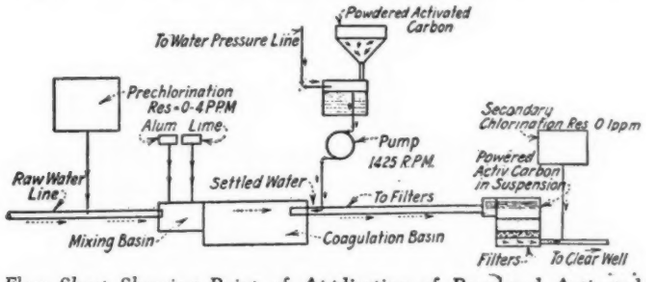
Just what materials are adsorbed from water by activated carbon is not known, but it is believed that nearly all organic compounds are adsorbed (some more freely than others), and many inorganic ones; and that all taste-producing compounds are adsorbed. Malcolm Pirnie says: "Tastes and odors due to sulphite liquor, aldehol, phenols and micro-organisms have been completely eliminated with the aid of powdered activated carbon in several plants. In other plants treating extremely polluted raw waters, satisfactory reduction in tastes and odors has not yet been secured with powdered carbon. Experiments at two of these latter plants have shown that passage of the filtered water through 30-inch beds of granular Hydrodarco will render the water tasteless." Since only a few of the matters dissolved in water are taste-producing, much of the adsorbing ability of activated carbon is used in removing these unobjectionable matters, just as a large percentage of the bacteria removed by a filter are perfectly harmless.

It should be noted that while chloramine prevents tastes by chemical reactions with the taste-producing substances, activated carbon removes these substances from the water.

Activated carbon was first used in water treatment in granular form as a filter medium,



Pressure filter for granular activated carbon, Kenshena Indian Agency, Shawano, Wis.

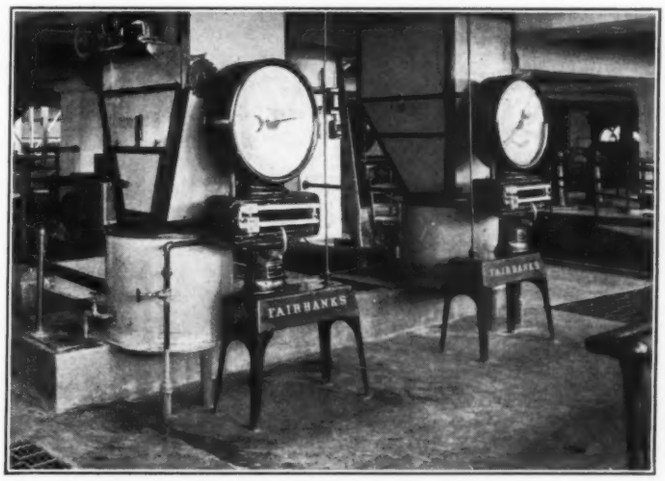


Flow Sheet Showing Point of Application of Powdered Activated Carbon at Filter Plant, Hamburg, N. Y.

being deposited in beds 20 to 30 inches thick, through which the water was passed either upward or downward at the rate of about 2 to 4 gallons per minute per square foot. The aim and result was the removal of tastes, particularly those due to chlorine, by adsorption of the taste-producing compounds.

Only a few of these carbon filters had been installed in municipal plants (although a number were in use by bottling works and other industrial plants), when the idea of pulverizing the carbon and mixing it with the water was tried in 1928-30 by G. R. Spalding at the New Milford purification works of the Hackensack (N. J.) Water Co. The idea was tested out at the South Pittsburgh, Pa., water softening plant in 1930, using Nuchar, an activated carbon pulverized to pass a 200-mesh sieve, and later by several other plants of the American Water Works and Electric Co. In December, 1930, the use of this material

(Continued on page 58)



Dry feed machine applying nuchar at Saginaw, Mich., filtration plant.

Incinerator for burning two tons per hour of coarse and fine sewage screenings.
South Yonkers plant of Westchester Sanitary Sewer Commission, located near large girls school and an orphan asylum, and beside main line of the New York Central Railroad.

Incineration of Sewage Screenings and Sludge

By Herbert W. Lincoln
Morse-Boulger Destructor Co.

ONE measure of the efficiency of any sewage treatment plant is its ability to remove suspended solids from the sewage flow. The time is very rapidly approaching when the efficiency and adequacy of a sewage plant will be based equally on its ability to continuously and economically dispose of the solids without nuisance, either at the time of disposal or at any future date.

The solids which are removed from the sewage flow in the various types of treatment plants and which must be disposed of, consist of bar screenings, fine screenings, sludge and skimmings and scum. These solids, if stored or dumped on an open field, are often the cause of considerable nuisance and are sources of danger to health. Fortunately the organic portion of the solids, which is the cause of the nuisance, can be burned. Regular daily incineration of sewage solids represents an excellent method of permanent disposal without nuisance. Efficiently designed incinerators operated in connection with suitable material handling equipment and, in some cases, dewatering equipment, have been proven to be practical.

Incineration is the process of destroying organic materials by fire. In the sewage field, incineration might further be defined as the art of subjecting indefinite mixtures of very wet, finely divided solids to the exact laws of combustion in a practical manner. The products of complete incineration are inert, odorless gases, and sanitary and inorganic ash. If incineration is complete there can be no nuisance either due to odors from the stack or at the place of final disposal of the ash.

The design of the incinerator should take into consideration not only the quantity of materials to be burned, but also their physical nature, such as moisture and ash contents and the fineness of the solids. Mechanical methods of delivering and charging the wastes which may be perfectly practical in a large plant are often not warranted in smaller plants. There are, however, certain fundamental requirements which must be incorporated in every incinerator design if the operation is to be economical and incineration is to be complete and without nuisance.

In order to understand some of these requirements it is necessary to consider the physical nature of the sewage wastes. The moisture content may vary from as high as 98½% for sludge removed from the settling tank, to as low as 70% or 75% moisture for solids which have been dewatered by mechanical means. The solids may vary from the finely comminuted materials which make up sludge, to the large lumps of rags and sticks removed from bar screenings. The ash content of the dry solids is also capable of variation from as low as 10% to as high as 50%, and may even be higher if grit is to be considered. In any case, the waste material is of such nature that fuel will always be required, and the incinerator should be so designed that the heat from the fuel will be efficiently used for burning the wet solids.

The solids must be dried before they will ignite and burn. The transmission of heat from a flame or from heated incinerator walls is entirely a surface action. A large hearth area must be provided in order to expose a maximum of suface for drying. It is obvious that a given weight of wet materials spread to a depth of 4″ will be dried and burned much more rap-

idly than if piled to a depth of a foot. Furthermore, there is very little conduction of heat from the surface of these wet solids into the mass.

The rate of heat transfer from hot gases increases rapidly with the luminosity of the flame. An incineration temperatures the rate of heat transfer to the wet solids may easily be four times greater with a radiant flame than from non-luminous gases of the same temperature. Furthermore, a great deal of the heat may be transmitted to the solids from radiant brickwork if located near the surface.

Wet solids must be stirred and stoked to expose fresh surfaces to the flames. In addition to the fact that the material is a very poor conductor of heat, it must be considered that when the surface of the material has become ignited, it greatly reduces the amount of heat transferred to it from the radiant sources above. For a large surface of material it is therefore important that every part of it be within reach of an access door, through which it can be stoked. If the material can be so charged through a multiple of holes that it is well spread over the large hearth area, the labor of stoking and spreading is kept to a minimum.

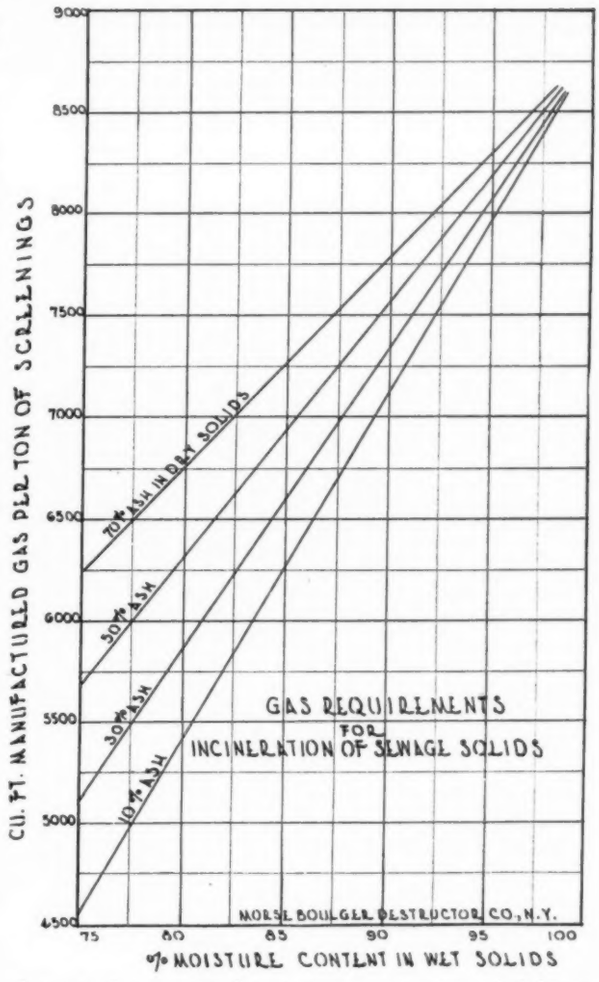
If the material is first spread on a hearth used only for drying and then is removed to a burning grate, the operator has to use considerable judgment to determine the proper time for transferring the material, for if it is moved too soon, it will not burn readily and may so retard the fire as to result in low temperatures.

The solids, when wet, tend to mat down and form a mass quite impermeable to air unless high draft pressures are used. If forced draft is used, the operator is charged with the additional duty of preventing the formation of holes through the fuel bed.

As the sewage solids are exposed to heat and dried, the combustible portions start to volatilize. The volatiles given off are odorous, and must be burned while moving through the gas passages of the incinerator if the incineration is to be complete. The requirements for burning the gases consist in proper provision for mixing them with air, and travel in the heated zone of the incinerator sufficiently long to insure time for mixing and for combustion. The difficulty of thoroughly mixing the gases with air is increased because of the high moisture content of the gases. The mixing may be aided by subjecting the gases to abrupt turns while traveling at high velocity. These abrupt turns tend to break up the stratification of the gases and bring the combustible particles into intimate contact with the oxygen. If the gases are at the proper temperature, they will then ignite and complete combustion will result.

The ash from sewage solids is ordinarily finely divided and readily carried by swiftly moving gases. A settling chamber of adequate size to reduce the velocity of the gases and cause precipitation of the ash particles is an important part of any incinerator.

For any given proportions of water, combustible and ash, the fuel requirements can be computed accurately. The heat available in the combustible portion is practically the same for all types of sewage solids. In most computations for fuel requirements it is assumed that an exit gas temperature of 1250° to 1400° is to be maintained. All materials introduced in an incinerator, whether solid, liquid or gaseous, must be raised to the temperature of the outgoing gases.



Amount of gas required to incinerate screenings of different moisture content.

From intersection of vertical line representing moisture content of screenings with inclined line representing percent of ash in dry screenings, carry horizontally to the scale on the left, which gives cu. ft. of gas required to burn a ton of said screenings.

Let us assume an outside installation where the temperature of the air and the sewage waste is 40° Fahrenheit. The temperature of the outgoing gases may be taken as 1250° Fahrenheit. Let us further assume a ton of sewage screenings to be charged per hour, the moisture content of the screenings to be 90%, and the ash content of the solids to be 15%. Then during each hour 1800 pounds of water must be heated from 40° to 212°, converted into steam, and then the temperature of the steam raised from 212° to 1250°. For this, each pound of water will require about 1640 B. T. U. Air is required for combustion of the 170 pounds of burnable material, and the temperature of this air must be raised from 40° to 1250°. As considerable stoking is required, the figure taken for the air requirement must be greatly in excess of that theoretically required. Each pound of air will require about 250 B. T. U. If the operation of the incinerator is to be continuous, the ash, which amounts to 30 pounds per hour, must be removed while hot and heat must be supplied to raise its temperature from 40° to 1250°. Each pound of ash will require about 190 B. T. U.

Heat must be supplied to make up for the radiation loss, which represents the heat conducted through

the walls and doors of the incinerator, and radiated through open doors while charging and stoking. This radiation loss depends upon the outside surface area of the incinerator, the thickness and kinds of materials in the walls, and the temperature gradient. It must be computed and estimated for each installation.

The heat available in the solids to supply these several requirements is 9,000 to 10,000 B. T. U. per pound of dry combustible. The difference between the total heat required and the heat available must be furnished by commercial fuel. The fuels ordinarily to be considered are oil, gas, coal and rubbish. The fuel to be preferred depends upon local conditions, but in most cases oil will be found preferable as it combines ease of firing and temperature control with comparatively low cost. In determining the amount of fuel for any heat requirements, it must be kept in mind that the total heat content of the fuel is not available for useful work in the incinerator. All of the gases resulting from combustion of the fuel itself must also leave the incinerator at the same temperature as the rest of the gases. The portion of the fuel heat thus lost is ordinarily about 30% or 35% of the total heat content of the fuel.

Although sewage solids are reluctantly combustible, if the incinerator is properly designed for burning them there is ordinarily less danger of nuisance from odors than in the case of the average private or municipal garbage plant. This is particularly true if oil or gas is used as fuel. The two requirements for operating a properly designed incinerator without nuisance are that the temperatures of the outgoing gases be 1250° or above, and that there be an ample supply of air. In most municipal garbage plants the principal fuel consists of rubbish, either mixed with the garbage or charged separately; and temperatures are therefore capable of considerable variation and may at times be too low for proper operation. In a sewage incinerator, however, the sludge or screenings are of more uniform consistency and the amount of auxiliary fuel necessary to be fired can ordinarily be kept quite uniform, and there should be little possibility that inadequate temperatures will result. With a uniform temperature, the rate of drying and burning the solids will tend to be uniform also, and there will be little variation in the amount of air required.

No municipality need hesitate concerning the installation of an incinerator for the disposal of sewage solids because of the possibility that nuisance will result. If the incinerator selected is designed for their particular requirements, any operator of average intelligence will be able to operate it easily without danger of odors.

Service Costs and Performance Records of Crawler Wagons

J. C. Johnston Construction Co., East Prairie, Mo., contractors on Piece 4C of the Birds Point-New Madrid spillway levee, recently released some interesting figures on the performance and operating costs of crawler wagons. These figures cover the period from June 14, 1930 to December 1, 1931. The type of work on which they were used was described, and the construction of the Birds Point-New Madrid levee outlined in the July, 1931, issue of PUBLIC WORKS.

The first two of Johnston's fleet of wagons were purchased in June, 1930; two others were added later that month, three in August, and two more in October. Between the date of purchase and December 1, 1931, these eight wagons operated 56,484 hours, an average of 7,060 hours per wagon. The total yardage hauled amounted to 1,609,213 yards, an average per wagon of 201,151 yards. The yardage handled by the two wagons oldest in service amounted to 472,490 cubic yards, or 236,245 yards per wagon, in an operating period of 7,935 hours each. This shows, for these wagons, an average per hour of operation of 29.7 yards; and the average for the fleet of eight wagons is 28.5 yards per wagon per hour of actual operation. During a large part of the time these units were operated 22 hours per day.

According to A. C. Powell, of the J. C. Johnston Construction Co., although the dirt from the bottom of the ditch was a mixture of sand and water and the top soil was silt with sand pockets, the crawler tracks therefore working continually in abrasive material, the two oldest crawler wagons, which last December had seen 7935 hours' use each, were still working on their original tracks and were possibly good for another thousand hours without track replacement. Two bearings had been replaced because damaged by allowing the axle nuts to become loose and strip. One set of tracks was repinned after working 5278 hours, but this was not really necessary, as the pins showed not over 1/16" wear and the bushings much less.

The cost of repairs for the eight wagons, operating an average of 7,060 hours each, was $2,720.29, or $340.03 per wagon. Per yard of material hauled, the cost of repairs was ($.0016). The average gasoline consumption per yard of material hauled was 0.16 gallon; and the average consumption per hour per tractor (sixty horsepower tractors were used for hauling) and wagon unit was 4.8 gallons per hour.

The wagons used on this job were LaPlant-Choate 7-yard Road-layer wagons, and the tractors were Caterpillar Sixtys.

Placing the Woonsocket Activated Sludge Plant in Operation

By Ilbert O. Lacy

Assistant, Dept. Sewage Research, New Jersey Agricultural Experiment Station

THE Woonsocket activated sludge plant has already been described in PUBLIC WORKS (October, 1931) and the present article adds only some new features installed after the completion of the plant, together with a discussion on the operation and cost of operation required.

The disposal plant, designed for a capacity of 4.5 m.g.d., is located in the geographical center of the town. The detention periods of the various units with this flow are about as follows:

Skimming tanks	6 min.
Preliminary settling tanks	1 hr.
Pre-aeration tanks	30 min.
Aeration tanks	4.5 hr.
Final settling tanks	2 hr.
Total	8 hr. 6 min.

Sewage Flow

The low-level sewer entering the plant is fed by lines, seven of which go under the Blackstone river. These siphons under the river are of such a nature that considerable amounts of infiltration are contributed to the regular sewage flow. This fact alone makes operation very difficult; several times the flow has become so great and risen so quickly (from a 3.5 m.g.d. rate to an 8 m.g.d. rate in three hours) that the aeration tanks were washed clean of floc. Provision is now made to bypass the sewage during heavy rain storms.

Accurate flow records are kept and figure 2 shows the average hourly rate of flow taken during two six-day periods. These periods do not represent the maximum or minimum flows, but tend to show the result of a high-water river against a low-level river. The rainfall during the high-level flow was .5 in., and during the low-level, .06 in. These two curves follow each other closely. The average difference in daily rate is 0.9 m.g.d., so that the detention periods during this "building up" process were changed greatly.

It was ascertained that the sewage flow from this line during the early morning hours, 1 a. m. to 4 a. m., held very little more than river water. This material had a turbidity of 30 p.p.m. and after three hours settling in a 500 c.c. cylinder the amount of settable material was insignificant. It was decided thereafter to bypass this portion of the flow until the sewer lines have been repaired.

Compressors and Air

The diffuser tubes are set four feet below the liquid level, between a baffle and the tank wall. This baffle extends to within one foot of the tank bottom and the top is approximately 3 feet below the liquid level. This placing allows the use of about 3 lb. air pressure. Measurements showed that a surface velocity of 3 ft. per sec. is usually found in the aeration tanks, with no settling on the tank bottom. The liquid level is about one inch above the deflecting baffle, producing a rippling effect on the surface of the liquid.

The air distribution is not equal in the different tanks. Aeration tank No. 1 (furthest from the sludge return house) receives more air. All attempts to

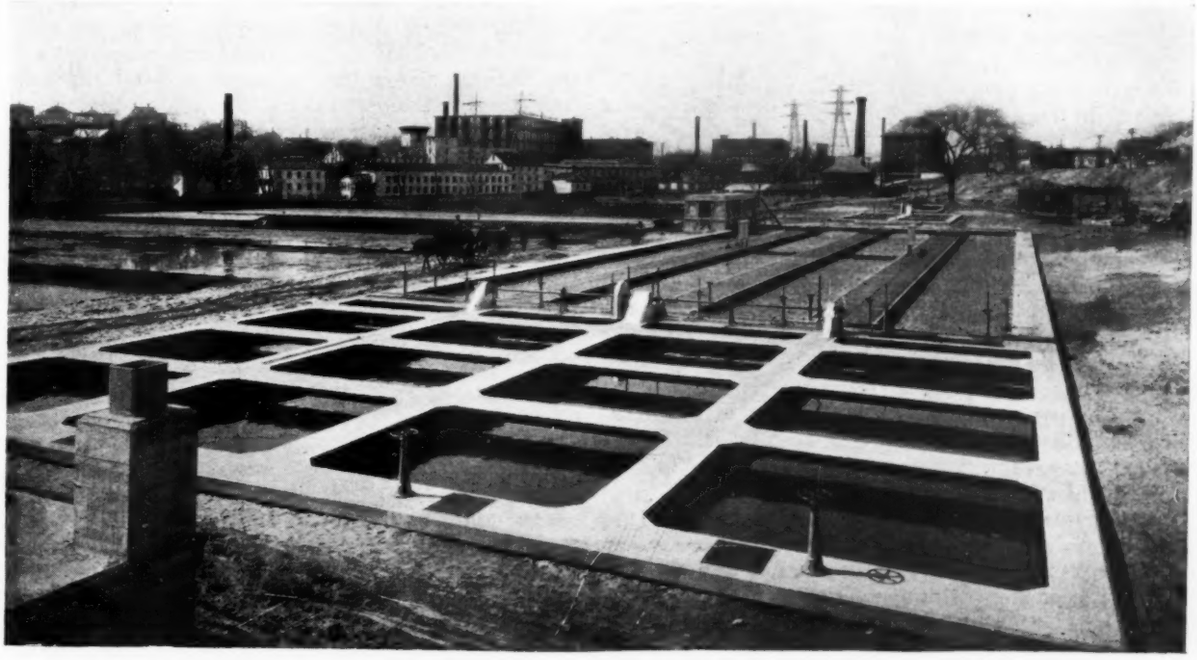


Fig. 1—General view of Woonsocket activated sludge plant.

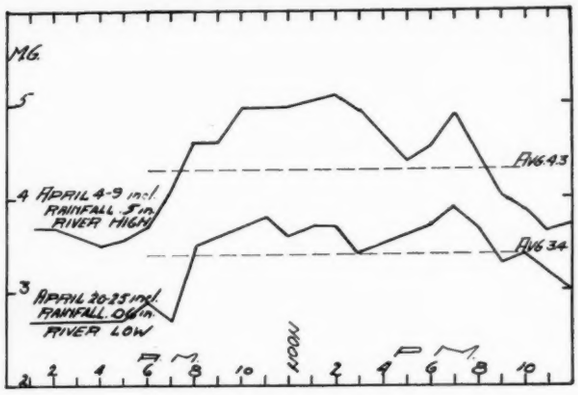


Fig. 2—Variations in sewage flow at high and low river.

equalize this air flow have been of no avail. Operation now is with all valves on the air lines wide open, while approximately 3750 c.f.m. is being delivered to an average of 3.8 m.g.d. sewage. The air pressure varies with the temperature, humidity, etc. The minimum and maximum pressures found were 2.7 lbs. and 3.4 lbs.; the maximum daily variation found was 0.4 lb. These variations were recorded with all the conditions mechanically similar. These same variations are reflected in the power consumption. With an air temperature entering the ducts to the compressors of 97°F, the air leaving the compressors was 122°F, and with an entering temperature of 60°F the air leaving the compressors was 100°F.

When No. 2 compressor is working and No. 1 is off, the air appears to come through the diffuser tubes at greater rates, even though the various recorders register the same as when No. 1 compressor is functioning. Another peculiarity is that No. 2 compressor uses less power than No. 1 compressor, both working under the same physical conditions.

Quite often during the early morning the air volume is low, but as the morning progresses and with no mechanical changes the volume picks up. On damp days the volume falls off somewhat. General Electric compressors are used. Each compressor is driven by an 85 H.P. motor and is kept in constant use for a period of three to four weeks, after which time the other compressor is used for a similar period.

Pumps

The sewage enters the plant from two levels. The low-level sewage (about 3 m.g.d.) has to be lifted about 20 ft. to the commencement of the treatment process, an automatically cleaned straight-line screen; the high-level flow (about 0.8 m.g.d.) reaches it by gravity. To raise the low-level flow the required height, three 25 H.P. centrifugal Morris pumps of the variable speed type are employed, each of which can be controlled either manually or automatically. These pumps have functioned perfectly at rates a trifle higher than 8 m.g.d.

The return sludge runs by gravity down to a pump well, from which it is lifted about 15 feet to the four sludge return lines. These two pumps also are variable speed pumps, with manual control, and are rated at 7.5 H.P. each. They are rated to pump 400 g.p.m. to 1200 g.p.m. No trouble has been experienced with these pumps.

In the sludge return house is an automatically controlled 5 H.P. drainage pump which lifts approximately 20 feet. There has been no trouble due to clogging of this, but trouble was experienced with the primer, which trouble was overcome by more control.

The two 7.5 H.P. centrifugal sludge pumps have caused the most worry and trouble. The bearings on the shafts are so placed that, with the sludge sump half-full, the bearings are submerged. Due to the action of the sludge drawn from the preliminary settlings tanks and the waste activated sludge, the bearings wear very quickly, and had to be replaced. This trouble was alleviated by using rubber bearings with a stream of water for a wash-out.

Other Mechanical Equipment

The screen has worked satisfactorily since electrical connection troubles were remedied.

The mechanical sludge removal equipment has given very satisfactory operating results. This equipment has operated continuously except for a short period when it was deemed advisable to remove a link from each chain.

The measuring devices have given little or no trouble in all cases but one. This one case was the device that measures the return sludge. Four venturi tubes are set vertical, with manometers and accessories on the floor above. Flanges placed over the bubble tubes were removed and a needle valve installed to control the air volume, the water line being so set as to allow only a slow drip. This water supply is to replace losses due to evaporation and not to clean. In order to equalize the air pressure, air valves must pass the same amount of air through both the throat and barrel side of the manometers. Changes were made in order to make such an operation feasible, but the difficulties were not entirely overcome.

Return Sludge Control

One feature of this disposal plant that was not included in the original design is a double channel in the front of the final settling tanks. The usual channel for return sludge extending across the entire width of the final settling tanks and connected with the return sludge line is augmented by two other channels that slope toward the center line of the settling tanks and are parallel to the return sludge channel and on the aeration tank side. These channels connect with a single line running down through the center line of the four aeration tanks, and sloping toward the influent end (see fig. 3). By having this last-named line (labeled waste or poor sludge) in the plan (with two added connections), a much more flexible operation is possible. This line is connected with the main drainage well, and through a pump to the skimming tank. Since it was on the main drainage line, the valve that would allow the material to flow into the effluent line is kept closed (labeled to river).

In operation, the plan works as follows: The operators learned that the return sludge to the aeration tanks functions more perfectly if the main line of the returned sludge is kept full; but if this line is kept full, the liquid level in the channel gradually rises, due chiefly to fluctuations in the flow. Assuming that the eight valves controlling the quantity of sludge removed from the final settling tanks are not changed, and that the main return sludge line must

run full, the liqiud level rises again. On each side of these sludge removal control valves is set a stop-gate. To keep the level constant, no matter what volume is being withdrawn, several of the gates on the aeration tank side are raised and the excess runs into this channel down through the line leading to the drainage well, from where it is pumped to the effluent end of the skimming tank.

This plan is somewhat modified in case one aeration tank becomes bulky or otherwise troublesome. In this case the gates, that allow the sludge removed from the final settling tank in question to enter the sludge reurn channel, are closed and the waste gates opened, so that all the material which is not in proper condition is put into the waste or poor sludge line and goes to the skimming tank. This poor sludge then has a chance to settle in the pre-settling tank before entering the aeration tanks. The good return sludge, uncontaminated with the poor sludge, is returned to the aeration tanks. If more sludge is being withdrawn than is necessary for operation, the excess is led directly to the digestion tanks.

The following operations can be carried on simultaneously:

1. Good sludge returned to aeration tanks.
2. Excess sludge returned to digestion tanks.
3. Poor sludge to the skimming tank.
4. Volume control excess to the skimming tank.

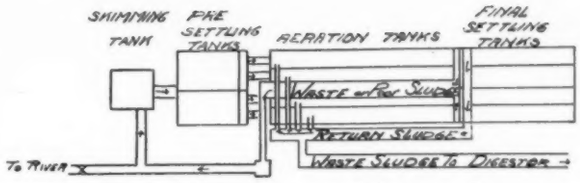


Fig. 3—Scheme of return sludge control.

Operation

The sewage entering the plant is a mixture of both domestic and industrial wastes, the industrial wastes originating in rayon, wool scouring, piece dye, and weaving mills.

Due to the large amount of grit entering the plant, the air supply in the skimming tank is kept at its maximum, thus causing the grease to be skimmed in greater quantities from the preliminary settling tank and less from the surface of the skimming tank than should be the case.

At frequent intervals a considerable blanket of heavy material of a fibrous character is found floating on the surface of the primary settling tanks. This material is collected at one end in a trough (regular equipment) and delivered by an added pipe line to a container at the end of one sand filter. After two and a half to three days' accumulation has drained somewhat, it is removed by pump and buried.

In endeavoring to return sludge to the aeration tanks, some difficulty was encountered. It is not possible to actually see the returned sludge enter the tank, so that the several times the sludge ceased running into the tanks, it was not until an hour or more had passed before the failure was discovered. Such failure was prevented by maintaining a pressure against the valves that control the volume; that is, if the sludge return pump is pumping at the rate of 500 g.p.m., each of the four valves is set to pass approximately 110 g.p.m. instead of 125 g.p.m., so that the pipe line is always full. Several other methods were tried without success.

Very little trouble is experienced in building up an activated floc to about 2000 p.p.m. suspended solids.

Primary settling tank sludge and activated sludge were sent to the digestion tanks, which received sufficient quantities of lime along with the daily addition of sludge to maintain a pH of about 7.2. Gas formation occurred quite radiply.* The supernatant liquid is being drawn on to the glass covered sludge beds.

(Continued on page 64)

Table 1.—Results on suspended solids in aeration tanks.

(susp. solids in p.p.m.)

No. aeration tanks	No. 1	No. 2	No. 3	No. 4	Average
May 6-21 (inc.)	794	665	891	820	793
May 23-June 8 (inc.)	1400	1380	1290	1826	1583
June 8-30 (inc.)	726	706	677	968	787

Table 2—Results on suspended solids in effluents from different units.

	Screen	Primary sett.	Final	Screen	Primary sett.	Final	Screen	Primary sett.	Final
May 6-21 (inc.)	453	116	111	1028	158	124	140	88	92
May 23-June 8 (inc.)	304	107	77	492	110	112	176	103	28
June 8-30 (inc.)	282	120	95	356	140	110	96	72	82

Table 3—Results on Biochemical Oxygen Demand in different units

	Influent	Primary settling	Final	% reduction Primary settling	% reduction Final
May 22	460	400	300	13	34.8
June 8	220	150	120	31.7	45.5
June 24	365	265	55	27.4	85.0

Table 4—Detailed Account of Operating Power Cost

Motor for	Number of motors	Rated horse power (each)	Operating K. W. demand	Hours of operation daily	K. W. H. daily demand	Daily cost aver. .016/k.w.h.	Costs for April	Cost per million gallons
						$	$	$
Sludge pumps	2	7.5	3.38	1	3.38	.05	1.62	0.017
Final settling conveyors	1	2.0	.45	24	10.80	.173	5.19	0.052
Sludge return pumps	2	7.5	2.37	24	56.88	.91	27.30	0.274
Drainage pumps	1	5.0	3.75	15	46.25	.74	22.20	0.227
Pre settling conveyors	1	2.0	.235	2	.470	.0752	2.26	0.023
Bar screen	1	.375	.375	1	.375	.060	1.80	0.018
Sewage pumps	3	25.0	* 23	24	552	8.832	264.96	2.700
Compressors	2	85.0	57	24	1368	21.880	656.40	6,700
TOTAL					2038.15	32.724	981.73	10.011

* Pumping 2100 g.p.m. (average rate). Compressing 3400 c.f.m. at 3 lb.

Table 5—Total Operating Cost

Salaries	$ 928.00
Chlorine (15 days)	45.00
Chemicals (hydrated lime)	7.00
Miscellaneous	25.00
Power	981.73
Light	27.18
Total	2014.21
Total treated (million gallons)	99.1
Cost per mil. gal.	20.25

* This was evidenced by the later unfortunate explosion of one of the digestion tanks. See *Public Works* for November, 1931.

The Gasoline Bootlegger A Threat to the Road Builder

By J. J. Smith
The Texas Company

EVERYONE connected with the road building industry, from the engineer who designs the highway down to the laborer who rakes asphalt, is vitally concerned by the activities of the gasoline bootlegger. An increasingly substantial portion of the funds necessary to construct and maintain the country's highway systems is derived from the tax on gasoline. Naturally, the more successful the gasoline bootlegger is in pursuing his crooked course of tax evasion, the smaller the contribution of the gasoline tax to road building. The result is fewer roads for the engineer to design, for the contractor to build, and for the public to use.

The income derived from gasoline taxation has grown by leaps and bounds. From $5,382,000 in 1921, collections from this source jumped to $148,-358,000 in 1925, while in 1930 they had reached a point just under half a billion dollars.

The usual method employed by the States in gathering the gasoline tax is to collect it from the refiner or the distributor or whoever makes the first sale in the State. The refiner or distributor passes the tax on to the dealer, who in his turn adds it to the price charged the ultimate consumer. There is a provision, however, that when gasoline is purchased in one State for resale in another, the first State will not levy a tax. This is the loophole seized by the gasoline bootlegger in all parts of the country. He purchases a supply of gas in one State, avoids payment of the tax by stating the gasoline is for export to another State. But when he transports the commodity to the other State, he has no intention of paying the second State's tax. Instead, the racketeer takes his bootleg goods to dealers as crooked as himself and lays his cards on the table. Sometimes the entire tax is deducted from the price charged the dealer for the gasoline. In other cases the racketeer and the shady dealer split the evaded tax between them.

The above practice is not local, but nation-wide, and millions of gallons of gasoline are involved annually. Louisana is a good example. J. T. O'Sullivan, executive secretary of the Louisiana Code Committee, is quoted in *Collier's Magazine* as saying:

> At almost any hour of the night, tank trucks and trailers may be seen moving along the dark roads which run into Shreveport from east Texas. Some of these trucks haul as much as 2,500 gallons of gasoline. Is it not peculiar that most of the gasoline should enter Shreveport after dark between 9 P. M. and 4 A. M.? The reason given for this is that traffic is lighter during the night and because the trucks are needed for local distribution during the daytime. But it is a very strange thing that these same trucks which enter Shreveport under cover of the darkness full of gasoline go out again the next day back to Texas through the heavy day traffic and when they are supposed to be needed in local distribution. The truth about the matter is that these trucks move at night to escape the inspectors and this gas coming into Shreveport, without paying tax in either Texas or Louisiana, has demoralized the honest gasoline industry of the state.

States are thus deprived of a substantial part of the income which they should be deriving from their gas tax. It is self-evident that the extent of the road funds available in each of these States is likewise reduced in proportion to the success with which the gasoline bootlegger plies his trade.

In some States the gasoline tax is collected quarterly from the dealer, who is allowed an additional sixty days in which to make his payments to the State. During a quarter of a year the gasoline dealer earns for himself only one-third or one-fourth of the amount he is called upon to turn over to the State in the form of taxes. This offers a temptation to the dealer, to which in many cases he has succumbed. This particular type of racketeer conducts his gas station business until shortly before the time arrives to pay the State the tax. He then quietly drops out of sight, pocketing the money which rightfully belongs to the State. Later, under an assumed name, he opens another service station elsewhere and repeats the same procedure. The result is a steady substantial drain

Courtesy Collier's Magazine

on the State's income from the gasoline tax, which is reflected by a reduction in the funds available for the construction and maintenance of roads.

The importance of the gasoline tax as a source of highway building funds cannot be over-emphasized. The proportion of the revenue from gasoline taxation which is devoted to State highway purposes varies from State to State, ranging from approximately 72% to practically 100%. An analysis of the gas tax revenue of sixteen representative States in 1930 reveals that on the average 88.24% of this income was devoted to State highway purposes.

1930 Gas Tax Revenue of Sixteen Representative States and Proportion Used on Highways

State	Total motor fuel tax receipts	Per Cent of fuel tax receipts used on state highways
Arkansas	$ 6,427,273	98.89
Colorado	6,144,826	97.03
Florida	13,622.215	72.08
Georgia	13,391,079	83.28
Idaho	2,668,582	99.68
Indiana	17,158,746	93.26
Louisiana	7,546,488	97.94
Maryland	6,991,188	79.17
Michigan	21,673,879	97.51
Mississippi	6,791,177	96.95
New Jersey	11,342,896	99.18
New York	28,476,290	94.83
North Dakota	1,969,304	99.39
Ohio	37,081,451	82.50
Texas	29,527,098	75.00
Wisconsin	8,314,841	92.80

An official report on 1931 gasoline tax revenue is not yet available. It undoubtedly will be found that an increased proportion of this income last year was diverted in some States to other purposes than highway work.

From the standpoint of his own personal interest and welfare, the road builder should cooperate with the various States, oil companies, and other organizations in combatting the gasoline bootlegger. Reputable oil companies, thoroughly aroused over the alarming spread and present proportions of the gasoline tax evasion racket, have pledged themselves to the common cause of stamping out the stupendous graft. The road builder can help this cause and aid in protecting the road building industry by refusing to buy gasoline at "bargain" prices, by reporting to State tax officials any station which is selling gasoline at such low prices as to raise a reasonable doubt in his mind whether the gasoline tax is being paid; and by bearing in mind that every time the State loses a dollar through tax evasion that dollar is added to the taxes on other commodities and activities which he and other law abiding taxpayers is forced to pay.

Courtesy Collier's Magazine

Extortionate taxes lead to dishonesty and evasion.

Courtesy Collier's Magazine

RECENT LEGAL DECISIONS

With Reference to Water Works Departments and Companies

By John Simpson

Contract for Supply of Water From Wells Outside City Limits

The case of Hevelone v. City of Beatrice, Nebraska Supreme Court, 234 N. W. 791, involved the validity of a contract between the city and a construction company by which the latter bound itself to supplement an indefinite and insufficient supply of good water obtainable through the municipal waterworks by the construction of certain wells, pumps, pipe lines, etc., without the city limits. The city agreed to pay certain taxes on the construction company's property, and reserved the right to purchase the improvements. The contract was held valid. The location of the proposed wells without the city limits was held no substantial ground of objection to the validity of the proceeding.

A "majority vote of the legal voters of such city" required by statute in a special election for the approval of the contract was held to designate the voters who voted, and not those who, although qualified to vote, did not vote at the election.

Liability for Water Supplied to Private Property for Fire Protection.

The Florida Supreme Court holds, Miami Water Co. v. City of Miami, 134 So. 592, that a water company which supplies the pressure and water for standpipes or automatic sprinkler systems for individuals or private corporations performs a service which is not included under its contract with the municipal authorities to supply water for fire protection, and a water company supplying such stand-by service has the right to make a reasonable charge against the private owner therefor. It has the right to cut off its connection with supply pipes leading to privately owned property upon the failure of the person, firm or corporation owning the same, against whom reasonable charges for services are made, to pay such reasonable charges. The standpipe, sprinkling systems, and other like instrumentalities involved in the case were required by the city building code to be installed by the owner in certain classes of buildings in certain manners described in the building ordinance and to be connected with the main lines of the water company at the cost and expense of the owner.

Cutting Off Water When City's Corporate Limits Reduced

The Georgia Supreme Court holds, Murray v. City of Waycross, 156 S. E. 38, that in incorporating a municipality or amending a municipal charter the Legislature may give such extent and boundaries to the incorporated territory as it may choose; and an injunction to restrain a city from cutting off the water supply from property excluded from the city by a statute reducing its corporate limits was denied.

City Not Liable for Displacement of Water Meter Box Lid

The Texas Court of Civil Appeals, Gatz v. City of Kerrville, 36 S. W. (2d) 277, holds that a city which places and maintains a water meter box in a much traveled sidewalk assumes the duty of using at least ordinary care to equip and secure it with such safeguards as are reasonably necessary to prevent injury to pedestrians. But where such a meter box, although not secured by catches or clips, had lain flush with the surface of the sidewalk securely and without mishap for six years, the city was held not liable for injuries to a pedestrian who had stopped to speak with friends in a car and was standing upon or moving about on the meter box, and whose foot went down into the opening when the lid became in some way displaced.

Water Company's Duty as to Shutting Off Water

A consumer of water called the water company and requested it to shut off the supply of water to her house at the property line, as the house would be vacated, which the water company apparently agreed to do. It was not done, however, and the pipes upstairs in the house became frozen and burst. The consumer sued the company for $1,000 as the damage caused her thereby, relying upon the company's agreement to shut off the water. The company relied upon its field rules and regulations and maintained that any contract pleaded was subject to these. It maintained that plaintiff had breached said contract, if any, by failure to drain the pipe in the house and shut off the water. It appeared that when notified to turn off the water the water company attempted to do so, but was unable to do so on account of the frozen condition of the ground in the street where the company's fixture was located for such purpose. There was located a valve inside the basement of plaintiff's house, where plaintiff could have turned off the water. Her husband went to the house, made an examination of the pipes, turned off a number of valves and turned off the water heater, but failed to turn off the main supply pipe from the street, so that the pipes froze.

The Indiana Appellate Court, Frankfort Waterworks Co. v. McBride, 175 N. E. 140, said, substantially, that, since the plaintiff was a regular consumer of the water company, whatever contract existed between the parties was entered into long before the plaintiff asked the company to turn off the water, and what that contact was was not before the court. The contract sued upon and alleged to have been entered into on that date was held to lack the important element of a consideration, and it lacked mutuality. The water company was the only one alleged to have promised to do anything, and since the plaintiff must recover upon the contract sued upon, and not upon some other contract which was neither alleged nor proven, she could not recover.

Expenditure for Water Main for Sewer District

The Ohio Supreme Court holds, State v. Board of Com'rs. of Summit County, 175 N. E. 590, that the expenditure of public money by a board of county commissioners for the purpose of constructing a water main, in advance of the board's ascertaining that a water supply can be obtained, is an unlawful expenditure of public money.

It is also held that the construction of a water main in a highway, outside a municipality, by such board, for the benefit of a sewer district and abutting owners, does not constitute an additional burden upon the fee of the abutting owners.

An Interesting Curvilinear Side-hill Street Job

By D. Y. Bate

Junior civil engineer, City of Los Angeles, Calif.

TRACT No. 8303, situated on the side of a spur of the Sierra Madre, with slopes between 1½:1 and 1:1, was subdivided in 1924 and subsequently sold to parties wishing to make of it a high-class mountain home area.

In 1930 a petition was presented requesting the construction of a full improvement, without retaining walls, under the provisions of the "Improvement Act of 1911."

A survey was ordered, but when the survey crew got on the ground, insufficient evidence was found for relocating the original circuitous 30 ft. dedicated streets. The exterior boundary was closed and a network of triangulation points was established. These data were turned in to the design office, where all points on the boundary and the triangulation net were co-ordinated; also a set of center line co-ordinates was established from the record map. The points of intersection of the numerous curves were then set from the triangulation net. This method was necessary, as it was next to impossible to reestablish the center line by re-running it on account of the many angles and the short connecting tangents.

Trial grades were then laid, allowing for 24 ft. of pavement with 5-ft. sidewalk and curbs, and for 24 ft. of pavement and curbs, respectively. Both of these grades gave excessive excavation because the slope of the ground was too steep to allow the construction of fills without the toes overrunning the streets below and one of the provisions of the petition was that no retaining walls were to be built.

The parties concerned were called for a conference and it was decided to design for 16 ft. of pavement and curbs, with curves widened.

The method of attack used was somewhat similar to the one suggested by Harger and Bonney in "Highway Engineer's Manual." The cross-sections, previously taken by the survey crew, were platted to a large scale and their locations were spotted on the co-ordinated map of the dedicated streets. Each section was then considered separately as if that one section were typical of the whole job, with the idea of deciding where would be the most advantageous location for the placing of the grade line, as the location of the grade line practically determined the alignment. These alignment locations were then placed on their cross-sectioned locations and an alignment that would best fit was drawn in, lengths scaled and a trial grade laid. After sufficient adjustments in this graphical layout had been made to give assurance that it was workable, an alignment was calculated which, with the narrowed width of improvement, gave opportunity to improve the poor alignment in the dedication. This calculated alignment was then placed on the cross-sections and a grade was worked out.

In laying this grade, no crown was provided in the pavement, curves of extremely short radius were widened and all curves were superelevated to a maximum for safety rather than for easy riding. A spline was used to lay the grade and no vertical curves were calculated.

The improvement alignment was tied to the property alignment by offset at the beginning and end of each improvement curve, and by stationing as normal to the property line on tangents and radially on curves. The beginning of a curve on the improvement was placed on its property line station on the profile, the length laid out and marked "length on curb" and the end of the curve marked "E. C. Curb." This elevation was then equated to the property line station at the end of the curve with a break in the grade line profile, and an equation shown, thus keeping the improvement profile and the property line profile in nearly relative positions. A detail was placed near each curve on the improvement map showing the distances along and offsets from the property center line to the beginning and end of all improvement curves, thus saving the survey crew a great deal of time when the improvement is staked. Fig 1 shows both the property and improvement alignment.

There were two intersections on the entire job and only one of them was difficult. Fig 2 shows the details of this intersection. The small figures denote the elevations of the finished surface, and near the curb the figures underneath the finished surface elevations denote the curb face; the figures on the property line denote the elevation of the original ground surface. As a final check on the design of this intersection, a model was constructed in moulders' loam, using a horizontal scale of 5 ft. to the inch and a vertical scale of 3 ft. to the inch.

Fig. 1—Improvement alignment.

On the approach to this intersection, on part of the intersection itself, and at one other location on the job, the "no retaining wall" provision of the petition was transgressed necessarily. Due to the extremely steep slope of the ground, support for the lower part of the improvement had to be provided to come within the limiting grade of 20%. A cantilever retaining wall was investigated and discarded on account of excessive cost, so a half-bridge section was tentatively designed and submitted to the Bridge Division, which redesigned the structure, reducing the cost.

The Water Department had no mains in this section, and to get sufficient head the installation of a booster and tank would have been necessary, so they are to lay the mains and services and lease them to a local water company which is developing water in a nearby canyon.

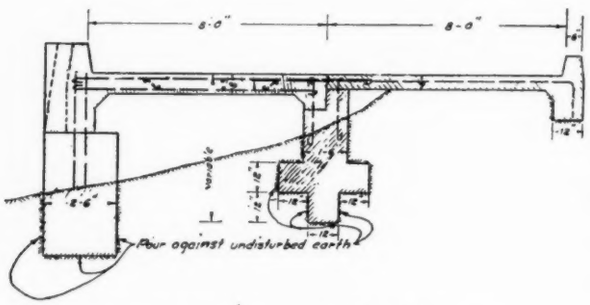


Fig. 3—Half-bridge section for side-hill street

Drainage was effected by catch-basins and pipe at the intersection of Sister Elsie Drive and Hidden Trail, at the intersection of Sister Elsie Drve and Springside Trail, on the curve on the Northerly side of Lot 545, down Alp Trail from Gyral Drive, and at Deerwood Trail.

The improvement will be advertised for bids as soon as the time required by the provisions of the "Improvement Act of 1911" has elapsed.

The writer has been on this class of work for the past seven years almost exclusively and believes that this was the most difficult as well as the most interesting job of his experience. On this job investigations were made on curve superelevation and widening, the results of which were noted in PUBLIC WORKS in June and September issues, respectively.

Ralph DeArmand and A. E. Wells III designed portions of this improvement; general supervision was by E. W. Merwin, assistant engineer. L. O. Turner is engineer of the San Fernando Valley District, in which this improvement is situated.

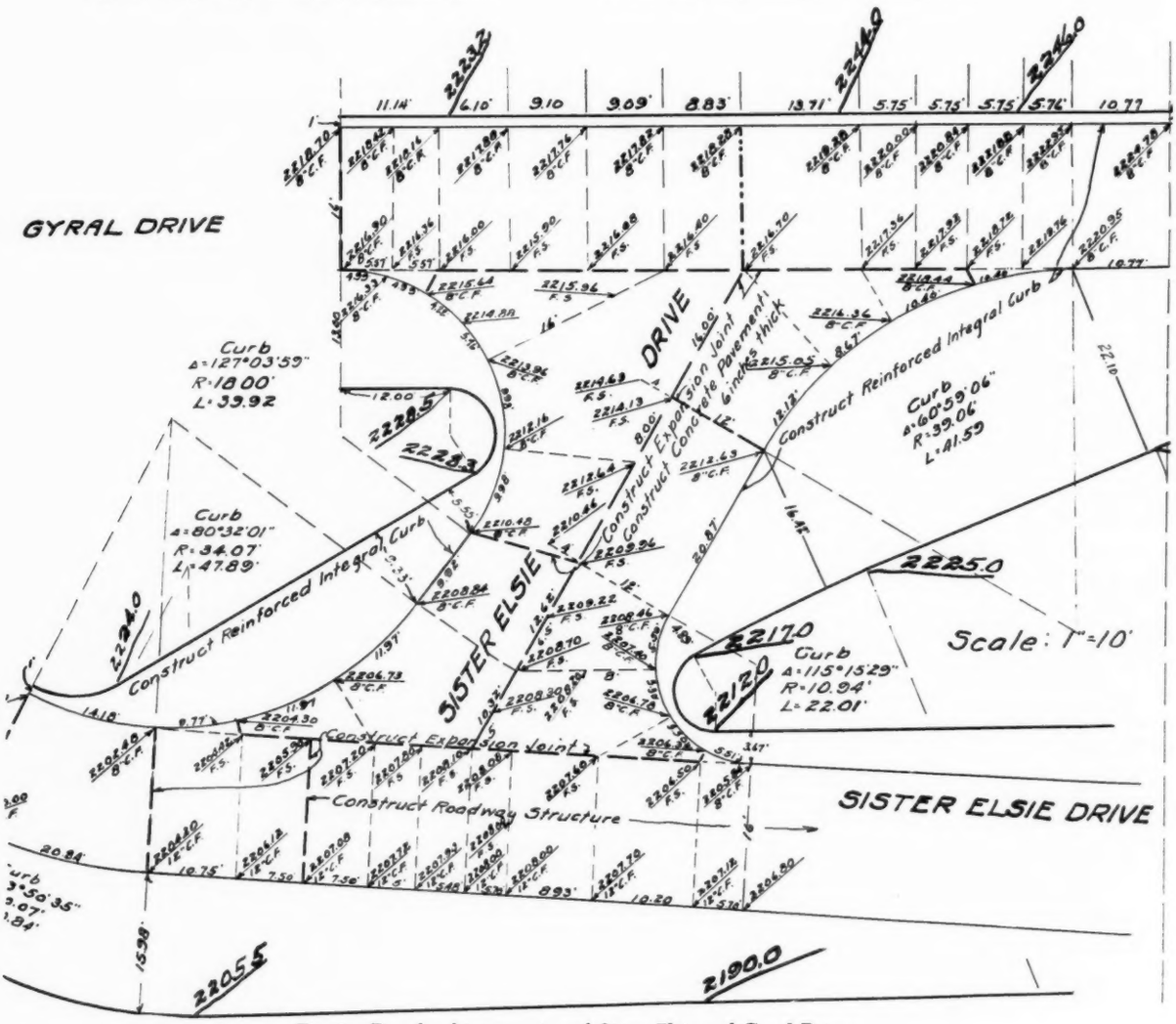


Fig. 2—Details of intersection of Sister Elsie and Gyral Drives

THE EDITOR'S PAGE

Popularity of Water Treatment

The American people have been educated to tolerate and even demand "chemical" treatment of their drinking water. A few years ago a howl went up in every community where it was proposed to use aluminum sulphate as a coagulant in connection with rapid filtration. Even physicians, who should have had intelligent knowledge of the chemical principles involved, protested against "putting chemicals in our drinking water."

Only a generation later we find citizens contentedly drinking water to which has been applied activated carbon to remove tastes and odors; chlorine to destroy bacteria; ammonia, sulphur dioxide, or sodium thiosulphate to prevent chlorine tastes; lime to remedy hardness, followed by soda ash or carbon dioxide; copper sulphate to prevent or kill algae; and aluminum or iron sulphate as a coagulant. Not many waters, perhaps, receive all of these, but there are few to which at least one or two of them are not applied, and this becomes increasingly true with the rapid increase in pollution of our surface waters.

With these and other proved materials at their command, together with filtration, aeration and other processes not involving the dissolving of corrective substances in the water, the water engineer and superintendent can produce a water both safe and palatable to consumers and acceptable to boiler users and manufacturing industries.

But to do so requires the cooperation of the expert knowledge of the designer and operator, with the pocket-book of the consumer or tax payer. Less than ever is water used by consumers "free as air"—unless they wish to carry home in buckets from the river or well the polluted or mineral-charged water that they find there.

To select from these various methods and materials those which will produce a water with the desired qualities most effectively and economically is no simple matter to be entrusted to one with little real knowledge of the chemical and physical reactions resulting, or to the commercial promoter of one or more of them. It is a matter for the study of those with broad and technical knowledge of the subject of water treatment, and their recommendations should be carried out in the operation of the plant by faithful attention of men trained to such service.

As for the finances, we believe it is the experience of most water officials that consumers generally are reasonable and reasoning, and that if it is explained clearly to them what is done and why, and what the water and death rate would be otherwise, and if the water delivered to them is uniformly palatable, there will be little complaint about the cost, which is less per family than that of their daily paper.

Emergency Highway Construction

Bills are now pending before Congress which provide for Federal Aid for increased highway construction. Work of this kind provides the maximum returns to the unemployed, while at the same time providing for badly needed roads. There is no overproduction in the highway field. Get in touch with your congressman and senator—again if you have already done so—and tell them why your community needs more and better roads.

Incinerating Sewage Solids

The chief problem in sewage treatment always has been and still remains the ultimate disposal of the solids. Ever since sewers and the water carriage of sewage were adopted, the principal aim of many workers in this field has been the utilization of the fertilizing properties of sewage. But success in this has not yet been reached except where special conditions prevail, as in arid countries where the water of sewage is itself of value for irrigation; and as trade wastes in sewage increase in variety and amount, the difficulty of attaining this end increases. Milwaukee spent many thousand dollars, with the cooperation of fertilizer manufacturers, in working out a method of manufacturing a marketable fertilizer from sewage sludge; but the cost has been found to be too great and it is reported that the manufacture will be discontinued.

It of course can not be stated positively that no process ever will be developed for utilizing the fertilizing properties of sewage that will cost less than the market value of the product; but until there is such a process, the aim must be to dispose of the solids in a way that is both sanitary and inoffensive and at a reasonable cost.

Perhaps the method that most definitely and permanently secures this end is incineration. This has long been applied to bar screenings and is proposed for dewatered sludge. What is awaited now is a method and appliances that will dewater and burn the sludge at a cost little if any greater than that of drying on sludge beds and disposing of the air-dried sludge.

Sanitary engineers will await with interest developments along this line. Some of the fundamental principles involved are discussed by an incineration engineer in this issue.

Highway Safety and Insurance

If the insurance companies which specialize in automobile liability and accident insurance were as much concerned with the prevention of accidents and highway safety as they are with their annual mark-up of rates, a great impetus might be given to the campaign for highway safety. Rates this year have been increased as much as 35 per cent in many localities. Life insurance companies have done remarkable work in the field of public health, and have found this work an excellent investment. If companies specializing in liability and accident insurance would cooperate with state highway and police departments, with such associations as the ARBA and other leading good roads associations, with police departments, with local chambers of commerce and with safety associations, it might pay them also.

Needed Water Works Betterments for Unemployment Relief

By Harrison P. Eddy
Consulting Engineer, Boston, Massachusetts

IN order to aid in the relief of unemployment, the American Water Works Association has appointed a Committee on Immediate Water Works Betterments. The committee, which is made up of consulting engineers, fire insurance men, water works men and public officials, has estimated conservatively that the amounts of money which could be expended in the United States in the immediate future to meet the most urgent needs of water works are as follows:

For reinforcement of distribution systems, including gates, hydrants and elevated storage	$200,000,000
For replacement of small pipes in distribution systems with pipes of adequate size	100,000,000
For extensions of distribution systems to give fire protection in outskirts of communities	50,000,000
For new or additional supplies or purification works, the need for which was demonstrated by the recent drought, and as probably represented in part by deficiencies in normal 1931 and 1932 budgets for water works improvements	200,000,000
Total	$550,000,000

This estimate does not include such large water-supply projects as are being developed or are under consideration for New York, Los Angeles and Philadelphia.

Need for Water Works Betterments. During 1929 and 1930 practically the entire country suffered from the effects of drought. In numerous instances, public water supplies were depleted seriously, and in some cases water had to be brought into cities and towns by motor trucks, to supply the deficiency. The scarcity of water in many cities brought inadequate fire protection as well as inferior quality of water. Thus the drought involved a grave menace to property as well as to public health, in addition to the inconvenience of a limited supply of water. In order to avoid similar conditions in the future, many cities need to make immediate improvements in their supplies. Such betterments might take the form of new water supplies, additional supplies to augment present ones, or purification plants to improve the quality of existing supplies.

Another class of water works betterments needed at the present time is the improvement of distribution systems. Such work, which in many cases has been needed for a long time, is required because of the normal growth of municipalities, both in area and in density of population. The improvements in question, which are needed largely for better fire protection, consist of reinforcement and extension of distribution systems and replacement of small pipes with larger ones.

Difficulties in Financing. Much of this betterment work would have been completed or would be under way at the present time, except for financial difficulties. In some cases local authorities have hesitated to advocate improvements which really are needed, because of the fear of criticism on the score of extravagance in municipal expenditures. In other cases municipalities actually have been unable to borrow money to finance needed improvements, even after the voters have authorized bond issues. A few of the cases which have come to the committee's attention will serve to illustrate the difficulties involved in financing projects under present conditions.

A town recently let a contract for approximately $300,000 for a new supply line and certain other water works improvements. The contract was made contingent upon the contractor's ability to sell the bonds, and he is to furnish all material and do a complete pipe-laying job. Thus far the contractor has not been able to market the bonds, although under normal financial conditions they would be considered a first-class investment.

A water improvement district voted $140,000 for a pipe-line installation some two years ago, but thus far it has not been able to market its bonds. These bonds should be an excellent investment, as they are a first lien on the property in the district, valued at some $5,000,000. There seems to be no other indebtedness, and the bonds would bear 6% interest.

In a city where very little pipe has been laid for the past two or three years, both extensions and new supply lines are needed badly. During 1932 the city should lay 200,000 to 300,000 feet of pipe, ranging in size from 6 to 16 inches. Recent efforts to provide funds by selling bonds resulted in rather unfavorable offers. Consequently, the budget may be cut and very little work may be done this year.

Many other examples could be cited, but these cases are typical of the difficulties which are encountered at the present time in providing funds for needed improvements. These difficulties are very largely due to the attitude of investment bankers throughout the country, most of whom, at the beginning of 1932, were opposed to the extension of public improvements which would necessitate an increase in the bonded indebtedness of states and municipalities under present conditions. These men have been urging public officials to adopt programs of strict economy, adjust expenditures to actual income, and restrict the incurrence of bonded indebtedness.

On the other hand, since the middle of February there has been a great improvement in the market for municipal bonds. Some bankers now say that those cities and towns which have not been extravagant in the recent past are having no trouble in selling bonds to finance permanent improvements at present.

Contrary to the general opinion, it now appears that American cities, on the whole, have not been unduly liberal in expenditures for permanent improvements during the past ten years. While it is true that such expenditures were increasing steadily up to 1927, population growth, rising price levels and improved living standards made this inevitable.

F. W. Herring* has shown that per-capita expenditures for permanent improvements in the 146 largest cities in the country, stated in terms of 1913 dollars, fell to a low point during the war years, and that in 1927 they reached a value only slightly higher than that of 1911, the previous peak. Since 1927 such per-capita expenditures actually have been decreasing.

Advantages for Unemployment Relief. The committee estimates that, if the $550,000,000 mentioned above were to be spent for water works betterments, approximately $330,000,000 would be paid for local labor, $200,000,000 for materials, and $20,000,000 for freight from foundries to point of use. The production and manufacture of the materials would furnish employment for much labor, pay freight on raw materials, and aid industry. The local municipal and corporate organizations are now in existence for performing this work, with the assistance of local labor of various kinds which are readily obtainable. A large proportion of such labor would be unskilled and would not need to have had previous experience. Furthermore, there need be very little delay in beginning construction work, after it is authorized and funds are made available, as plans for a large proportion of this work are already in existence.

If this method of relief were followed, little if any land would have to be acquired, as the work is largely in public streets and on lands already owned. On much of the work little machinery could be used advantageously. All the work involved would produce real values which would pay their way and be paid for by the people benefited. In other words, the property produced would be part of that needed for water service and fire protection, utility services for which charges can be made locally which are usually commensurate with the value of the service rendered.

For those municipalities in which water works betterments are needed and which are able to finance such projects at the present time, it would be distinctly advantageous to proceed with such work at once, from the standpoint of low cost as well as that of unemployment relief. The Engineering News-Record index of construction costs in March, 1932, stood at 157.24, compared with an average of 205.38 for the years 1923 to 1931, inclusive. This represents a decrease in cost of 23.4%, based on the average for the past nine years. In other words a project which would have cost $100,000 if undertaken during 1923-31, now would cost only $76,600. Even if the bonds, issued to finance the work, were to bear interest at the rate of 5½%, instead of 4½% as in previous years, interest charges for the first year would amount to only $4,220 for such a project undertaken now, as compared to $4,500 during 1923-31. Sinking-fund charges, of course, would be about 23% less than formerly.

If needed water works betterments continue to be postponed, along with other municipal construction work, the time is bound to come when many cities all over the country will start construction on many projects at one time. Population growth continues, and living standards will not be lowered permanently, however much they have been forced down during the past two years. It is hardly likely that the demand for municipal services of various kinds will decline. Therefore, after the present period of uncertainty passes away, city programs of construction will be continued with renewed vigor. When that time comes, costs undoubtedly will rise materially.

*Eng. News-Rec., 1932; 108, 365.

Conclusion. At the present time, there are many cities with programs of needed water works betterments which have been held in abeyance, due to lack of funds. If this improvement work were undertaken immediately, many men now unemployed could be engaged in a type of work which eventually would pay for itself. Furthermore, work done at present prices would result in a material saving, as compared with prices which have prevailed during the past nine years.

The committee has presented these facts to various members of Congress and has appeared before a Senate committee, in an effort to guide Federal aid, if granted in any form, into the water-works betterment field, where the funds made available would be expended on works of permanent value. Attempts also have been made to enlist the interest of the Investment Bankers' Association of America in providing funds for such an undertaking. Thus far these efforts have resulted in little, if any, progress.

In view of the radical change which recently has taken place in credit conditions, is it not possible for water-works superintendents and engineers to present the case for immediate water-works betterment work so forcefully to mayors, councils and boards that favorable action will be secured? It seems to the writer that herein lies a great opportunity for the water-works fraternity to secure a result which thus far has not been obtainable through legislative action —a result which would benefit not only the unemployed but also many other citizens. For it should be borne in mind that, although it is not an extremely difficult task to make jobs for the unemployed, water-works betterment work has the advantage of relieving unemployment profitably.

The Annapolis Metropolitan Sewerage District

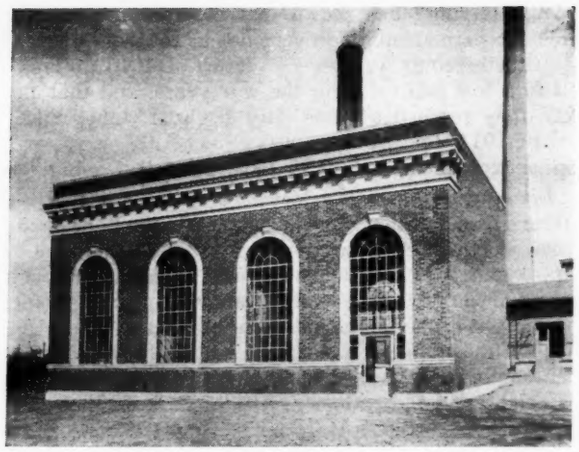
In the state of Maryland, probably the most important development in the sewerage field for the year 1931 was the creation, by an act of the 1931 General Assembly, of the Annapolis Metropolitan Sewerage District, which comprises all of the drainage areas of Back creek, Spa creek, Dorseys creek, and the parts of the drainage areas of Weems creek and the Severn river, in which are located the communities of Annapolis, Eastport, Germantown, West Annapolis, Wardour, and the United States Naval Academy and other federal properties. The Sewerage District, which is under the jurisdiction of a commission of five members, three appointed by the mayor and aldermen of Annapolis and two by the commissioners of Anne Arundel county, has been organized and considerable preliminary engineering work accomplished. The undertaking will involve a probable expenditure of about $700,000.

Light and Power Rates Under Municipal Ownership

The engineering firm of Burns & McDonnell has spent six months in compiling the light and power rates, valuation of property, operating expenses, earnings and other conditions pertaining to 100 municipally owned plants scattered from Massachusetts to Florida and from Washington to southern California, some using steam, some Diesel, while others are hydro-electric. Several are competing with private companies. This information they have published in a 70-page pamphlet.

Water Softening Plant for Marshall, Missouri

By Bransford W. Crenshaw
Henrici-Lowry Engineering Co.,
Consulting Engineers, Kansas City, Mo.



Softener building, Marshall, Missouri.

MARSHALL, Missouri, is a town of about 8,000 population lying in central Missouri about 90 miles east of Kansas City, in the center of a rich agricultural district. The city has owned its own water system since 1903, and its electric plant since 1919. The water system now represents a capital investment of some $375,000, of which only $90,000 came from bond issues, and the remainder from earnings. Water and light rates, as well as taxes, have always been very low in Marshall.

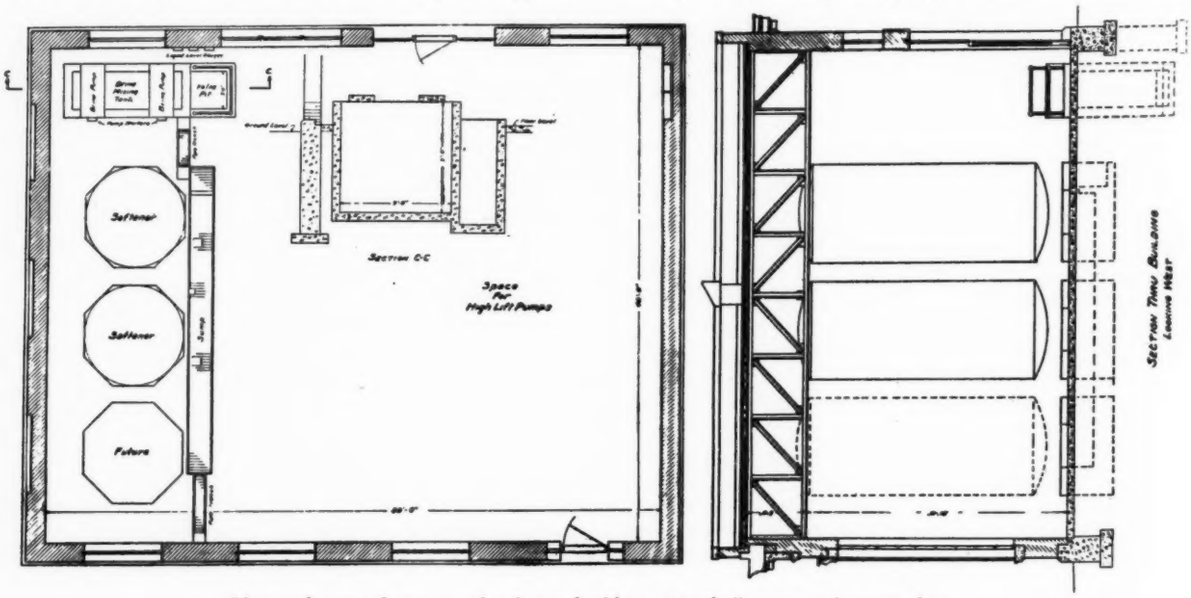
The success of these departments has been largely due to the activities of a bi-partisan Board of Public Works, which manages all of the affairs of the two departments, composed of capable and public spirited citizens. The board at present is composed of L. B. Tracy, James A. Walker, Paul Groeschel, and Grover C. Waters; with W. F. Fisher as secretary of the Municipal Utilities, and A. W. Kirby as superintendent.

The water supply is obtained from an abundant underground supply of clear, sparkling water of good taste reached by wells about 130 feet deep. At present there are eleven wells, part of which are standby. The practice has been to deliver the water from the well pumps through a flow line to two storage reservoirs with a total capacity of about 675,000 gallons, from which it was pumped by high-lift centrifugal pumps directly into the distribution system and an elevated tank of 200,000 gallons capacity. The total annual demand in recent years has been about 140,000,000 gallons, which is an average of approximately 381,000 gallons per day. The maximum day's consumption is about 640,000 gallons, and the minimum 200,000 gallons.

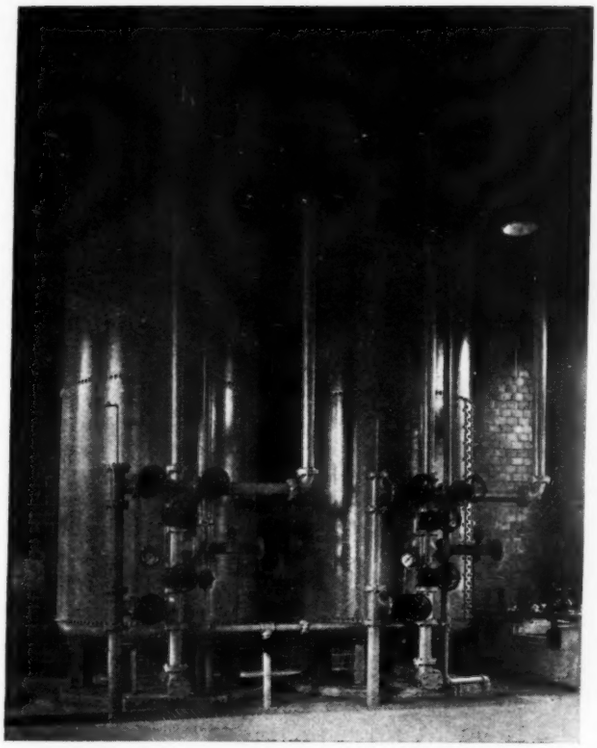
In years past, the quality of the water delivered was highly satisfactory to the citizens. However, the increasing discussions and applications of soft water during recent years awakened the officials and people of the community to the facts that their water was hard and that soft water would be very desirable. A large number of tests extending over several years indicated that the average hardness of the water was fourteen to fifteen grains per gallon. A representative analysis follows:

	Gr. per U. S. Gal.		*Gr. per U. S. Gal.*
Silica (SiO_2)	1.41	Nitrates (NO_3—)	0.00
Iron (Fe++)	0.04	Total solids (100°C)	29.53
Alumina (Al_2O_3)	0.04	Free CO_2 (CO_2)	1.34
Calcium (Ca++)	4.22	Hardness (in terms of $CaCO_3$)	
Magnesium (Mg++)	0.98	Due to lime salts	10.55
Sodium (Na+)	4.49	Due to magnesia salts	4.07
Bicarbonates (HCO_3—)	14.19	Due to iron salts	0.00
Carbonates (CO_3--)	0.00	Total hardness	14.62
Chlorides (Cl—)	7.36	Temporary	11.65
Sulphates (SO_4--)	2.26	Permanent	2.97

The Board of Public Works therefore decided to have an investigation made, and asked the Henrici-Lowry Engineering Company, which had been their



Plan and vertical section of softener building, Marshall water softening plant.



The two softeners in the softener building.

consulting engineers on water works, electric plant, and valuation work for nearly twenty years, to make preliminary investigations, estimates, and recommendations.

The general practice in softening a city supply has been to use lime as the softening reagent. However, the increasing use of zeolite type softeners and their adoption by a few communities led to the consideration of this type also. After a careful study of the first costs, operating costs, and operating characteristics of both types of installation, the engineers recommended zeolite equipment, and were authorized to prepare plans for installing it.

This treatment may be applied either in open filters similar to rapid sand filters, or in pressure-type shells of the usual commercial design. The demands for the city of Marshall were well within the capacity of the commercial type equipment, and as the first cost was less, this was the equipment recommended, Several of the more important points entering into this decision were as follows: The Marshall water supply is very clear, and requires no filtering; therefore a zeolite plant was much lower in first cost than a lime installation, which would require the construction of a filter plant as well as treating basins. A zeolite plant does not require the careful operation and control necessary with the lime plant; it is very flexible as to the degree of softening obtained, as this control is simply a question of the amount of raw water by-passed; and in operating cost, considering supplies, labor and interest, the zeolite plant compared favorably with the lime plant.

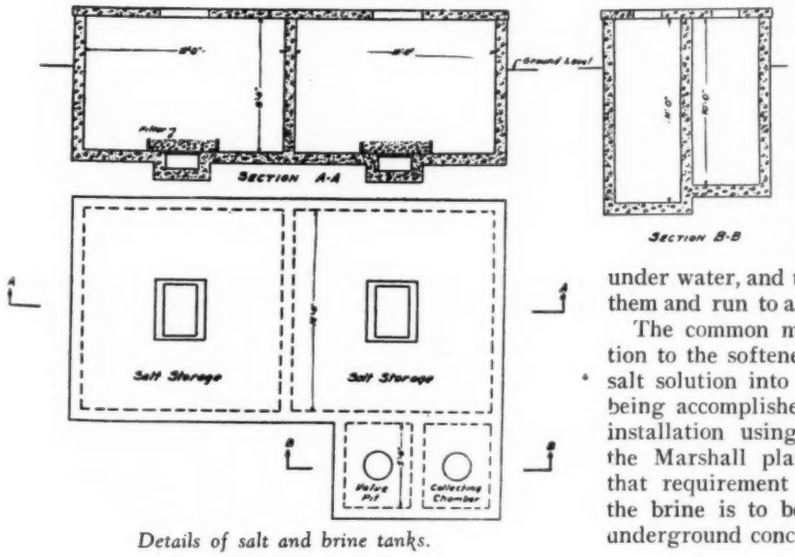
Under normal operation at Marshall, the well pumps are run during a much longer period each day than the high-lift pumps. Therefore, in order to keep the size of the softening equipment as small as possible, it was decided to pump directly from the wells through the softening units, and then into the storage reservoirs. This method, in addition to decreasing the capacity necessary for the softening equipment, required no extra pumping units, did not change the existing plan of operation, and assured a large supply of soft water at all times.

Pulsations from the well pumps will be absorbed by a cushion tank in the softener building.

In order to keep labor costs at a minimum, the specifications stated that, under maximum demand, each of the two softening units need be regenerated not oftener than once in twelve hours; and that, while one unit was being regenerated, the second should be capable of handling the entire flow. The latter requirement was made because the well pumps are about a half-mile from the softening plant and it was not desirable to have to shut down a number of wells while regenerating.

Automatic proportioning equipment was specified which would regulate the relative amounts of raw and soft water entering the reservoirs, and be capable of being adjusted to supply mixed water varying from about 1 grain to 8 grains in hardness. It is expected to supply water of about 4 grains hardness to the consumers, but this may be varied to meet conditions or demands.

Due to the presence of some iron in the raw water, very rigid guarantees were required as to the continued capacity and efficiency of the zeolite mineral supplied.



Details of salt and brine tanks.

It is expected that the plant will require approximately 55,000 pounds of rock salt per month for regeneration purposes. This will be purchased in carload lots, and in order to store it, two concrete storage tanks were designed, each capable of holding a car of salt and located on the railroad switch. The salt will be stored in these tanks under water, and the concentrated solution drawn from them and run to a mixing tank inside of the building.

The common method of introducing the salt solution to the softener units is by injecting concentrated salt solution into the units, the dilution of the brine being accomplished in the injector. However, in an installation using the large quantities of salt that the Marshall plant will require, the engineers felt that requirement of closer control was justified, so the brine is to be diluted to proper strength in an underground concrete tank, and then pumped through

the units. The pumps used for this purpose may also be used to wash the units, and to circulate the brine in the salt storage tanks to increase the concentration. All washing and regeneration operations will be carried out with untreated water.

The specifications included rate-of-flow controllers on the softener units, recording and indicating meters for raw and soft water, alarm meters, etc., so that the plant will be fully automatic and the only manual operation required will be the control of the well pumps and the regeneration of the units.

The building was designed fireproof throughout, and finished on the inside with glazed tile. It is large enough to accommodate the two present softener units, one additional unit to be installed in the future, and the high-lift pumps which will be moved from the present old building to this new building at a later date. It was also designed for a future addition to accommodate shops, storeroom, lockers, etc.

Contracts for the plant were let in two parts, the first covering the building, salt storage tanks, and brine tanks; the second covering the furnishing and installation of the softening plant equipment, pumps, meters, etc. The successful bidder for the building was Henry R. Willems of Marshall, and the Lakeside Engineering Corporation of Chicago was awarded the contract for the softening equipment.

The softening units furnished are manufactured by the Lakeside Company and are vertical shells 8 feet in diameter by 18 feet high, having a mineral bed nearly 12 feet in depth. Each unit contains about 600 cubic feet of zeolite mineral of the "Green Sand" or "Natural" type, furnished by the Zeolite Chemical Company. The units operate on the upflow principle, and the manufacturer has specified a maximum flow rate of 8 gallons per square foot per minute, and a minimum of 4 gallons. The pressure drop through the mineral bed will probably be about two pounds. Control equipment consists of standard Simplex Valve and Meter Co. pressure-type controllers, provided with a simple adjustment by which the raw water and softened water can each be delivered in any desired percentage of the total mixed water flow. The same company provided manometers to indicate the flow through the softeners, and indicating, recording and totalizing meters for both raw and softened water.

It is expected that the units as installed will have a softening capacity of about 4500 grains of hardness (as calcium carbonate) per cubic foot of mineral, and that the salt (NaCl) consumption will be approximately 0.35 pound per thousand grains of hardness removed. It is also expected that the small amount of iron in the water will be removed, and will not seriously affect the zeolite mineral.

The total cost of the plant, including building, salt and brine tanks, softening equipment, meters and control equipment, piping, etc., will be approximately $30,000.

The Board of Public Works at Marshall will welcome the inspection of this plant at any time by interested parties.

Paving Washington Street Memorial Bridge, Wilmington, Delaware

By Alban P. Shaw

County Engineer, New Castle County, Delaware.

WASHINGTON Street Memorial Bridge over the Brandywine creek in Wilmington, Delaware, is a reinforced concrete structure of five spans, with a total length of 720 ft. and a 40-ft. clear roadway, the center lane of which is occupied by a double line of trolley tracks.

The bridge carries an immense amount of traffic every day, year in and year out, being located on a main thoroughfare over which all the through bus lines from the north, south, east and west are routed. The local and suburban traffic is very heavy at all times, particularly so during the morning and evening rush hours.

It had been surfaced twice with different kinds of bituminous material and patched and repatched time and again, but each material would creep and crowd up, particularly at the expansion joints and gutters, causing low spots here and there where water could not drain away and presenting for the most part a rather unsatisfactory riding surface. Cracks also appeared in many places where water seeped through to the sub-base, causing considerable maintenance troubles.

After determining that the arches were designed for sufficient dead load to permit using a heavier roadway surfacing, it was decided to pave the structure with 3″ vitrified paving brick that would conform to the most rigid specifications for such surfaces, and the services of the National Paving Brick Association of Washington, D. C., were solicited. They recommended that the bricks be laid on a ¾″ tar-sand cushion with a compacted thickness of at least ½″ and that an approved grade of asphalt filler be used to provide for the necessary expansion of the paving, which recommendations were adopted.

The bridge deck was constructed with a slightly noticeable vertical curve, the high point of which is about 20″ above the south end and about 6″ above the north end. The roadway surface was built to a crown of 4″ and the rails of both tracks set to that curvature. The drainage of the surface was thus assured so far as the structural details were concerned, so it was only a matter of securing a fairly even surface in the paving to get a satisfactory runoff.

The specifications required that the finished surface be tested with a 6-ft. straight edge laid parallel to the center line of the roadway and any depressions greater than one-quarter of an inch were to be corrected.

The existing concrete sub-base was thoroughly prepared by screeding grout over any existing low spots; and the tar-sand cushion, after being screeded with a crown templet to a ¾″ thickness, was rolled with a hand roller to a firm bed not less than ½″ thick.

The longitudinal alignment of the joints was obtained by the use of nails accurately spaced in the bottom of the templet which was moved over the cushion after the final rolling of same, and the lines for the guidance of the bricklayers were thus made straight and parallel. The bricks were then laid and

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Washington Street bridge, Wilmington, Del.

hand tamped to a firm bearing, using long planks to uniformly distribute the tamping, after which the entire surface was rolled.

In the dummy track, the bricks were laid parallel with the rails. Between the tracks, the bricks were laid square to the rails.

The 12 ft. traffic lanes each side of the tracks were laid herring bone style with only one kind of special cut brick on the outside edges, there being two rows of brick laid parallel to the outside rail, and four rows laid parallel to the curb forming the gutter.

The whole pavement is rather unique and pleasing and at the same time affords in a measure a sort of non-skid surface.

After a portion of the surface had been laid, the exposed surface of the bricks was given a coat of lime, just plain whitewash, care being taken that none of the lime entered the joints. This required considerable time, but it was found that if any lime got into the joints, the asphalt filler would not adhere to the bricks.

The asphalt was carefully tested to see that it conformed to the specifications in every respect, and after being heated to a temperature of at least 360° Fahrenheit, it was poured over the surface and worked into the joints with squeegees until the joints were completely filled.

After the first coat of asphalt had set, a second coat was then applied to fill in all the settled joints and in about fifteen minutes the asphalt could very readily be removed in sheets with scrapers from the surface of the bricks, which were soon cleaned of the whitewash either by rain or by traffic.

The asphalt that was scraped from the surface was found upon analysis to contain less than .1% of lime, and while that amount would not affect the ductility of the asphalt, the continued repetition of the use of the waste would build up the lime content to such an extent that the filler would be too hard and brittle. Therefore, the waste was limited in use to 50% of the old to 50% of new asphalt and the remaining used asphalt was removed from the job.

Since the paving was being done in the winter season, the work of cutting off the surface asphalt was found to be more easily accomplished if it were started about 15 minutes after the application of the second coat, for if the removal were left until the following day, the asphalt became hard and brittle and chipped off in small pieces thus making the work more tedious and laborious.

Dirt or sand on the edges of the rails was also found to be detrimental to the adherence of the asphalt in the joint adjacent to them, and in many cases the asphalt came off immediately, leaving recesses where water and dirt could easily collect.

Where test bricks were selected at random and dug up, the filler was found to be very tenacious and to completely fill the joints.

The entire surface is thus bonded into a solid mass, and the traffic keeps the surface of the bricks exceptionally clean. It has been noticed that oil from passing cars does not stain the slightly glazed surface of the bricks and that all such droppings are washed off during each rain.

The advisory services of the National Paving Brick Association is very greatly appreciated and we take this opportunity of thanking them for their sincere efforts in our behalf.

The above paper was presented before the twenty-sixth annual meeting of the National Paving Brick Association.

Culex and Aedes Mosquito Control by Arsenic Compounds

Control of Anopheles larva production by means of Paris green is familiar, and its use has proved very valuable on work designed for health protection only. Floatable Paris green has no effect, however, upon yellow fever (Aedes) and pest (Culex) mosquitoes, since the larvae of these species feed beneath the surface.

A sub-surface Paris green has been developed. Reports of laboratory tests at Tulane University and by the United Fruit Co. have indicated that this is effective in killing all Culex and Aedes larvae. Field tests are now being carried on. It is believed that, since dust can be applied by aeroplane, but oil cannot be applied in the same way with any degree of efficiency, that the addition of this sub-surface floating dust will enable a much better degree of control to be applied to the yellow fever mosquito, and to all biting mosquitoes. It is also hoped that this will prove a much better material for the control of Anopheles than the surface floating dusts.

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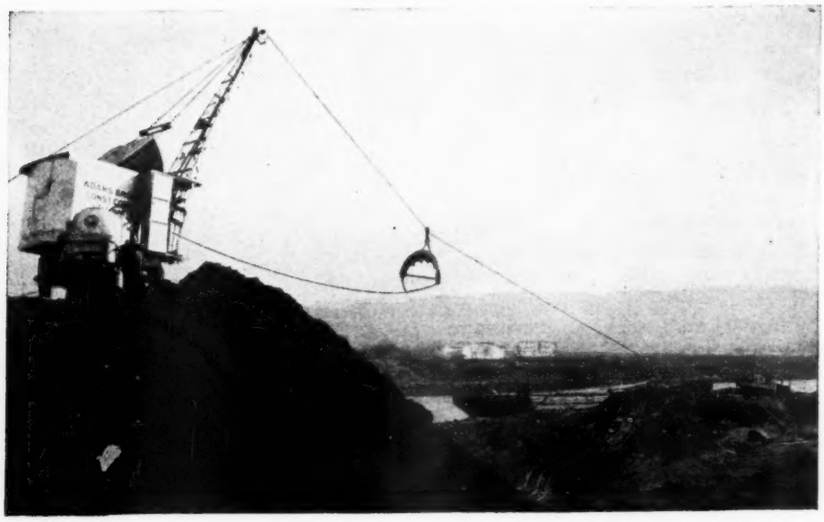
HIGHWAYS and PAVEMENTS

Truck Crane With Drag Scraper Saves Rehandling Dirt

In planning the construction of an approach embankment for a railway bridge crossing the New York State Barge Canal at Comstock, New York, Adams Bros. Construction Co. of Glens Falls found that the height of the embankment and the width of the borrow pit made it impossible to handle the cut and fill in a single operation of a dragline or crane with any of the customary bucket attachments, even had they used a large crane with 50-ft. boom.

By equipping a Bay City truck-crane with a 1-cu. yd. Sauerman "Crescent" drag scraper and slackline track cable for "gravity-return" operation, the contractors completed the job with only a single handling of material from the farthest edge of the borrow pit to the top of the embankment. The job involved about 20,000 cu. yd. of earth, and the contractors estimate a saving of fully 50% due to the single handling of the borrow.

In rigging up a crane or dragline for this type of operation, the drag scraper is equipped with a simple carrier that rides a cable which is anchored at the outer end of the excavating span, and passes over a sheave at the top of the boom to one of the crane drums. A second drum operates the load cable which pulls the drag scraper. In operation, the track cable is slackened off while the bucket digs its load and is pulled by the load cable over the surface to the desired dumping point. Then the operator pulls the track cable taut by a few revolutions of the corresponding drum, lifting the bucket into the air; the bucket, being bottomless, deposits its load automatically when lifted. Then the load cable is allowed to unwind from the other drum and the carrier, operated by gravity, carries the bucket back down the track cable to the desired digging point. The cycle is then repeated. A set-up of this sort combines the mobility of the dragline or crane with the long working range of the drag scraper, and provides a rapid and simple method for digging and moving materials over spans of several hundred feet.



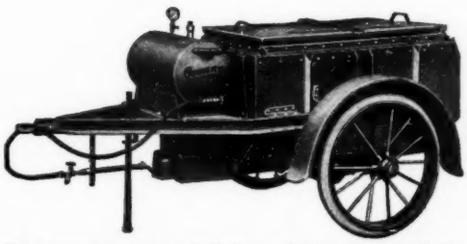
Scraper and Crane Building Up an Embankment for a Bridge Approach.

Machine Finishing Pavements

A JOINT committee of the American Road Builders' Ass'n. and the American Ass'n. of State Highway Officials, reporting in January on "Equipment for Spreading and Finishing Pavement," said: "The constant improvement of the mechanical finishing machine to the present stage of development has materially aided in the production of satisfactory riding surfaces and more durable pavements. The successful use of the finisher for many years on concrete pavement work has led to its adoption on bituminous construction where the results obtained thus far merit careful consideration."

In the case of concrete pavements, it recommends that the use of mechanical finishing machines be required; reporting that the highway departments of at least twenty-five states now require their use.

For bituminous pavements it says that mechanical spreading and finishing has been applied successfully to both surface and base courses of practically all types of bituminous pavements, including two-course sand-asphalt, bituminous concrete, natural rock asphalt, and sheet asphalt. Any mix that is suitable for hand raking can be finished easily and conveniently by machine, but some of the patented mixes have not been handled mechanically due to their consistency or to the method of application of the various courses.



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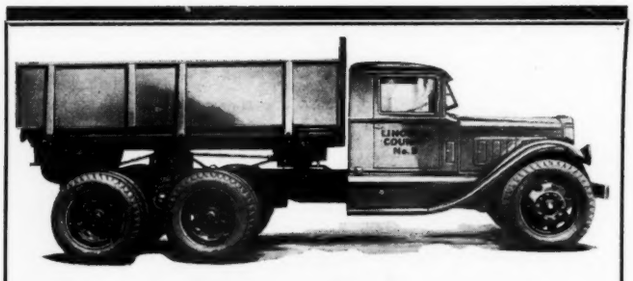

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especially after they have become cold. Bituminous concrete mixtures have been laid cold successfully when the elapsed time between plant and job has not exceeded 24 hours, but that which is shipped in cars is too stiff to be properly handled by a finisher, particularly in the thinner top course. The standard concrete finishing machine with only minor modifications is adaptable for use on bituminous pavements.

After studying the practices in thirty-two of the states, the committee reports the following conclusions and recommendations:

For Concrete Pavements: On wide special sections consideration be given, in the design and construction, to the adaptability of mechanical finishing; and, in conformity with Standards of Practice adopted by the American Association of State Highway Officials, that pavement widths be designed in multiples of 10′ as far as possible, as this will facilitate the use and standardization of finishing machines in addition to providing other advantages.

Satisfactory results are obtained by both the screeding, and screeding and tamping method. The use of the double screed predominates and there is an inclination toward a return to tamping in combination with the double screed where harsh mixes are encountered.

Finishing machines should make at least two trips over the surface, and more if necessary to obtain satisfactory results.

Machines are available for surfacing widened curves on 10-foot slabs without the use of false forms provided the widening does not exceed two feet. On slabs wider than 10 ft., it is recommended that the normal width be surfaced with the finishing machine using an inside temporary form. The finishing of the widened portion may be accomplished by hand screeding with care being taken that bond is obtained between the widened portion and the main body of the slab. Hand screeding is also necessary on irregular portions of intersections and for other special conditions.

Particular difficulties are encountered by manufacturers and contractors through the elimination of crown on curves, not only in finishing the surface but also in maintaining uniform thickness of slab; and it is recommended that the crown of the slab be retained on curves and, if considered desirable to compensate for the loss of super-elevation on outside of slab, the total super-elevation be increased to offset this loss. Experience indicates that this method results in a smoother, better surface than can be obtained otherwise.

Specified surface variation of less than $\frac{1}{8}$″ when tested with a 10 ft., straight edge is impracticable, but with good construction methods the $\frac{1}{8}$″ requirement can be met and is recommended as suitable practice. A substantial support for the forms and careful straight-edging of forms and form joints prior to placing concrete are essential to obtain this result.

Satisfactory spreading of concrete by boom and bucket is being generally obtained by modern equipment. An adequate spreading device is required for placing concrete from truck mixers or central mixing plants in standard width pavements.

In placing reinforcing mesh or bar mats, it is recommended that the concrete be struck off to the specified elevation of the reinforcing by the use of either the hinged plate attached to the finishing machine or the independent strike-off board which is pulled ahead by the paving mixer. Placing such reinforcing by the use of sled or sliding members is not recommended.

The mechanical finishing machine snould be used on concrete base construction.

A roll of material should be carried ahead of front screed not to exceed two-thirds of its height. This practice relieves undue strain on the machine, assists in maintaining uniform crown and surface results. Experience indicates that approximately $\frac{3}{16}$″ of excess crown in the front screed is required to secure specified crown. The arc of a circle conforms so closely to a parabola for pavement crowns ordinarily used, that equipment design to provide for a crown to conform to an arc of a circle should also be acceptable for a parabolic crown without modification.

It is recommended that the following maximum limits be set for the operation of a single finishing machine:

175	Linear feet of pavement			10′	wide	per	hour
140	"	"	"	18′	"	"	"
120	"	"	"	20′	"	"	"

These limitations must be further reduced where the finishing machine is used to strike off concrete below the tops of forms for placing reinforcements, on two-course pavements, or on very steep grades where concrete with stiff consistency is used.

For Bituminous Pavements: Fifteen states have used mechanical finishing machines on bituminous material and are favorable to its continued use, subject of course to the general limitations outlined.

It was unanimously reported that the finishing machine has improved the smoothness of the riding surface and materially reduced construction costs as well as increased daily production.

From the information available, there is definite indication that more uniform density is obtained through the use of the mechanical finisher.

Spreader boxes contribute to the uniform initial spreading of the material and reduce the cost of construction.

With the use of mechanical finishers, the smoothness of bituminous pavements may be required to be 3/16" when tested with a 10' straight edge.

In order to secure more satisfactory results with mechanical finishing machines, steel forms should be used and they should be given the same care and attention in setting and checking with a straight edge as forms for portland cement concrete.

Where there are considerable inequalities in sub-grade or old road to be resurfaced, it is recommended that a leveling course be placed to eliminate wide variations in thickness of binder course, which under rolling cause serious waves due to varying amount of compression and which again affects the top course smoothness. Where conditions require, a binder or substantial leveling course shall be placed beneath the forms for their support and alignment.

California Builds Highways Through Municipalities

The state highway system of California reaches 202 cities, and in nearly every one a fairly well defined route through the city has been designated or established by usage, which might be described as the route of the state highway through the city.

The total length of such routes within the corporate limits of these cities is 457 miles, or about 6 percent of the total state highway mileage.

The paving and maintenance of these routes was left to the cities until 1925, when state legislation provided for improving routes through municipalities of less than 2,500 population. By the 1931 statutes, the highway commission is empowered to determine the location of such route through any city, acquiring right of way where necessary; to improve this "to the same width and to the same standard as the state highway on either side of such municipality;" and to pay for them out of the regular highway funds. Or the municipality may be given the right of condemnation and may contribute any part of the cost of construction or improvement of such route.

Conforming to this enactment, the highway commission has adopted the following policy:

Upon the request of the city authority by proper resolution, the California Highway Commission will determine the location of a routing connecting the highways on either side of such municipality to form a continuous highway or highway system as will be of the greatest benefit to traffic upon such State highway; will adopt and take over such routing; will construct or improve such connecting portion to the same width or to the same standard as the State highway on either side of such municipality, paying for such improvement with State funds appropriated or available for such purpose.

On State highways which are main traffic routes, the municipality will be required to furnish to the State a right of way 80' in width, free of encumbrances and obstructions, and usable only for road or highway purposes. Sidewalk space, if desired, is to be provided by the municipality in addition and outside of the 80' right of way. The intent and purpose of this provision is that ultimate development of the highway may be carried to a 76' width between curbs.

On State highways of less importance and carrying a limited volume of traffic, a modification of the above requirement may be made to the extent that sidewalk space may encroach on the 80' right of way but only to the extent that a 56' ultimate width of roadway is provided.

Where it is clearly evident that State or through traffic

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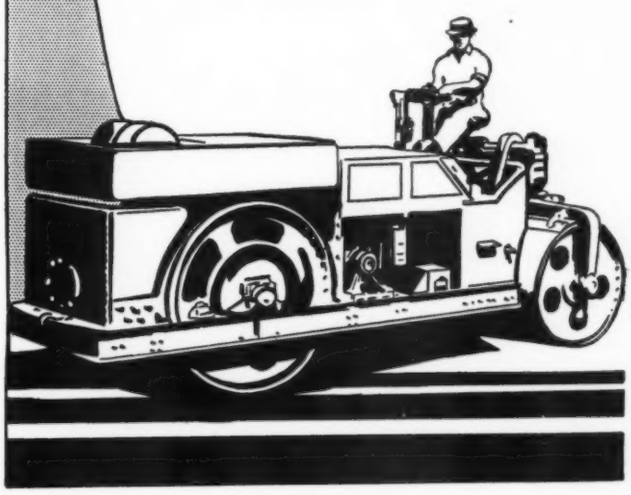

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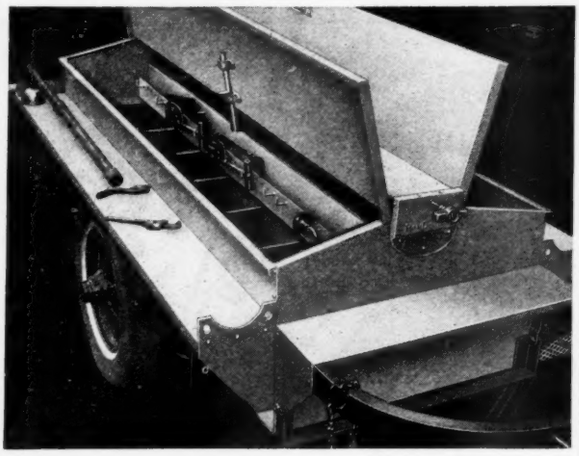

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is sufficiently benefited or benefited in greater proportion than will be local traffic, the State may consider sharing in the cost or in the removal of obstructions of the 80′ right of way.

Construction of curbs and sidewalks and the improvement by paving or surfacing of the remaining width of roadway between curbs not improved by the State will be an obligation of the municipality and should be defrayed from municipal funds available for such purposes. Installation, removal, or renewal of water, sewer, gas, and such other facilities under municipal jurisdiction shall be done at the expense of the municipality.

Upon completion of the improvement of the routing, the city is to resume jurisdiction and take back the improved routing and maintain the same.

On the basis of the provision in the new enactment that the State construct and improve the connecting route within the city to the same width and standard as the State highway on either side of the municipality, *the total amount of State construction cost on the 457 miles of city thoroughfares, not including right of way or major structures, can be roughly approximated at from $20,000,000 to $25,000,000.*

An appropriation of $2,700,000 is included in the present highway budget for the 83d and 84th fiscal year biennium (July 1, 1931, to June 30, 1933) for improving routes within municipal limits. The total revenues for this period for state highway purposes are estimated at $63,322,500, of which maintenance will require 21.38 percent, and only 62.17 percent will be available for construction. Of this amount, the $2,700,000 is a little less than 7 percent.

Mineral Fillers for Sheet Asphalt Pavements

A committee of the Association of Asphalt Paving Technologists has been investigating the practice as to use of mineral fillers in sheet asphalt wearing surfaces, taking as representative of general practice 42 specifications, including those of the Asphalt Association, American Society of Municipal Engineers, Chicago Paving Laboratories, Western Laboratories, states of New Jersey, Pennsylvania and Michigan, and 35 cities.

These specifications provide for 23 different materials, only 7 of which, however, are mentioned by more than one specification. Limestone dust is permitted by every specification except those of the Borough of Manhattan, N. Y.; Milwaukee, Wis.; Omaha, Nebr.; and Sacramento, Calif. Portland cement is included in all but Am. Soc. of Municipal Engineers, New Jersey, Pennsylvania, Buffalo, Milwaukee, St. Paul, St. Joseph, Cheyenne, Seattle and Montreal—32 in all. The next most popular is slate dust, used by 11 states; stone dust, by 8 states; dolomite dust, 4 states; silica dust, 4; and approved mineral dust, 3.

Each of the other 16 materials was mentioned only once. Many of these, however, might well be included in one of the above. For example, "levigated limestone" and "limestone dust 80% calcium carbonate" could be included under limestone. "Silica dust 95% pure silica," shale, rock dust, "hard durable rock," levigated stone, could be included under stone dust.

There seems to be no relation between kind of dust and fineness specified. Twenty-five specify that 100% must pass a 30-mesh sieve, and these include all of the leading seven materials and most of the others. Three require 100% to pass a 40-mesh; four require 100% to pass a 50-mesh; four to pass an 80-mesh; and one (Montreal) to pass a 100-mesh. The others have no requirements for 100%; but two require 85% to pass a 200-mesh, and two 70% to pass a 200-mesh.

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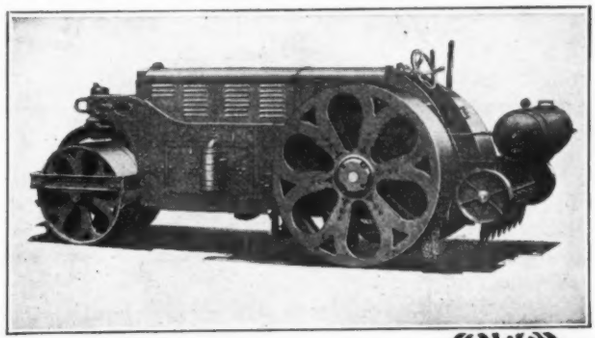

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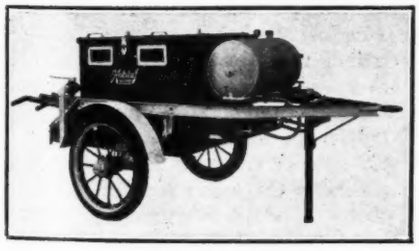

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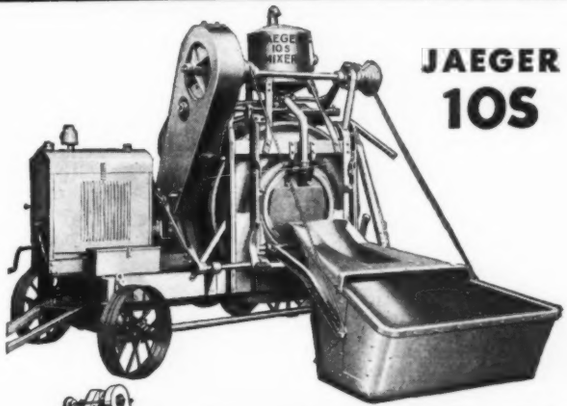

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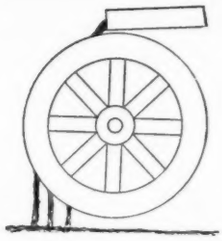

By
Jack J. Hinman, Jr.

The essential features of important articles of the month having to do with water works designs, construction and operation and water purification, arranged in easy reference form and condensed and interpreted by a leader in the water works field. Published every month to include articles appearing during the preceding month.

WATER **requirements** of cities vary enormously. The type of use made of the water and the manner of selling it apparently have the greatest influence on the volume required, though the quality of the water has some effect. Recent tabulations by Imbeaux[104] of water use in France in 1930 indicate a range from 1850 liters (493 gallons) for Marseilles to 25 liters (6⅔ gallons) per capita per day for La Roche sur Yon, in the Vendée, Paris with a daily consumption of 459 liters seems to be more normal. Change from flat rate to metering usually results in a drop of 50%, as at Macon, Georgia[119], or even more. Ohio rates[96] ranged from 7 gallons for Rockford to 260 gallons for Bluffton.

The **Chenery Water Supply Project**[53] in California is unusual in that it is planned to take water from the Sacramento river, during periods when the water is not too salty, and pump it to an impounding reservoir to await use. A horizontal cylindrical **intake screen** has been built at the Crystal Springs dam of the San Francisco water department for the purpose of eliminating vortex action[40]. Barberton, Ohio[86] has planted **pine trees** on the slopes of its reservoir with the intention of reducing erosion of the slopes. The Federal Governmnt is spnding about half a million dollars a year in **erosion studies** at present and it is hoped that the information secured will include actual data on the relation of forests to water supply[122].

Dresden[39] is taking water from the Elbe river, filtering through rapid sand filters at a high rate, and then spraying the water onto sandy soils from which it is **recovered through wells,** and then softened and treated to remove manganese. Los Angeles is treating a **colored well water** successfully with ferric chloride[137]. **California well practice** has been recently explained in a series of articles[56, 57, 58]. Ground waters present many difficulties, not only in securing enough water of good mineral quality, but also in avoiding **hazards to the sanitary quality**[115]. O'Fallon, Illinois[4], decided to buy filtered river water from East Saint Louis, eight miles away, rather than continue to depend upon wells.

Steel sheetpiling was used to carry New York's Water Tunnel No. 2 through a fault zone under the Bronx river[36]. At the new Hudson Bay Railroad terminal at Churchill, Manitoba, the piping is laid above ground on small piles driven 6 to 8 feet in frost and then covered with an embankment of four or five feet of moss[18]. The **cover** given pipes varies as a rule with the severity of the winter weather. At Saint Paul, Minnesota[2], there is usually eight feet of earth cover for services. In some recent British work, large diameter **concrete pipes** were loaded by rolling the sections up the inclined floor of a dump truck body by means of a power hoist[100]. The sections loaded were secured in place by cross timbers and the body brought to its normal position. Two sections of pipe could be hauled at one time in a truck with body wide enough to take the pipe transversely. Unloading could be accomplished quickly.

Daniels[59] discusses objectionable features common in pumping plants and distribution systems of the water works which he has inspected as a fire protection engineer. Much of the information is given in bare outline form, but is suggestive of ways to secure needed betterments. The satisfying of **peak demands** for water seems to be most commonly attempted by providing elevated storage tanks[117]. Lehr describes current **German practice** in this regard[49]. The **submerged-motor** pumping units used in the wells of Frankfurt am Main, Germany[43], have been described at length by Viesohn.

Two interesting summaries, each detailing 25-year periods of service in water purification, have appeared; one by Sir Alexander C. Houston[68], of the Metropolitan Water Board of London; the other, by Thomas H. Tristram[87], of the pioneer rapid sand filter plant at Lorain, Ohio. John R. Baylis[139] presents very practical advice on the **application of coagulants** to water treatment from the viewpoint of the plant operator, while Charles R. Cox[114] discusses the subject from the laboratory side. E. C. Trax [125] in a humorous way tells how important it is that the public know and appreciate its water supply system and understand the protection which the quality of the water is receiving.

Of recent filtration plants, none has been more carefully described than that at **Niagara Falls, Ontario**[34]. Buswell explains some fundamental points in water **softening** and in particular the difference in the solubility of calcium and magnesium carbonates and the effect on the necessary lime dosage which is involved[123]. In operating the water softening plant at Marion, Ohio, C. C. Whysall[95] found that plenty of water for slaking the lime and the use of thin-walled, easily-cleaned hose to carry the solutions were important aids in preventing stoppages in the **solution feed lines.** Mr. Whysall has also been able to dispose of the **sludge** from water softening to farmers who wish to use lime on their land[88].

The magazines are publishing a large number of papers on the subject of **tastes and odors** in water, especially chlorophenol tastes. The phenols from **gas works liquors** have been studied by Key[107]. Superchlorination followed by dechlorination by means of **sodium bisulfite** has been successful at Glencoe, Illinois[142]. The use of the **ammonia-chlorine** process has been helpful at Akron[81] and Cincinnati,[82], Ohio, at Chatham[15], Guelph[13] and Wallaceburg[17], in Canada,

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and elsewhere[11]. Probably the greatest interest in any of the current remedies for taste troubles has been aroused by **activated carbons.** Reports of the use of activated carbon at Defiance[92], Sandusky[90], and Warren[91], Ohio, South Pittsburgh, Pennsylvania[89], New Toronto, Canada, and many other places, have appeared recently. In general, the use of the carbon seems to have been attended with success; an exception is the report from Warren, Ohio.

Iron removal plants recently installed at Warrenton, North Carolina[126], and at Lansing, Kansas[6], are of small size and cheap construction. The Warrenton plant includes a two-tray coke aerator and a pressure filter. The Lansing plant has an aerator of the "Aer-O-Mix" type, but has no filter.

High test **hypochlorites** for special and emergency chlorination are urged by McMahon[135].

Cumming is quoted [136] as having estimated that about 96% of the **typhoid fever** cases at the present time are caused by **carriers** of the disease and that only about 4% of the cases that are diagnosed are due to water, milk, flies and other agents. Nevertheless, water works operators need to use every care to avoid contamination of their water supplies. Carriers will probably become less and less prevalent, some by recovering from the condition, the others by death. It is estimated that there were about 1568 carriers per 100,000 of the population in 1910, 671 in 1930, and that there will be only about 16 per 100,000 in 1960. An interesting note tells of a **check valve** in a cross connection being held open by the body of a living crawfish caught between the valve and its seat[118]; no pollution of a public supply appearing to have occurred, however, on account of additional protection. Larvae of a **midge** growing in a clear well at Cincinnati attracted attention by their active movements and their bright red color[94].

The work of Arthur I. Kendall[97] which indicates that bacteria including the typhoid organism may go into a state which permits them to **pass the finest filters** and may later resume their usual characterisics, may or may not have a significance to the water works industry.

Current interest in the bacteriology of water continues to center about methods for the detection of organisms of the **colon-aerogenes group.** Miss Ritter[63] reports on comparative experiments with fuchsin broth (O.8 ml. saturated alcoholic solution of basic fuchsin to 1 liter of standard lactose broth) which has been used by the Kansas water laboratory since 1921. Getrust[84] has experimented with his "modified bile broth" medium (standard lactose broth containing 0.357% ox gall). Rosemary Bole[83] working with standard lactose broth, Getrust's modified bile broth and 2% brilliant green lactose peptone bile finds the last of the three to be the best. Evans and Bahlman[85] at Cincinnati, found the standard lactose broth to be preferable to modified bile broth and to Dominick-Lauter medium. Minkewitsch, and Rogosin[143] recommend a medium composed of 10% skim milk, 0.5% peptone and the remainder tap water, used in manner similar to other fermentation media. Jones, Orcutt and Little[66] as well as Kennedy, Cummings and Morrow[67] have concerned themselves with coli-like bacteria which grow very slowly in a typical manner. These organisms have been found in the discharges of cattle suffering from intestinal disorders and may be mistaken for **paratyphoid** organisms.

Beal, Unangst, Wigman and Cox have found that the average daily intake of **aluminum** by the individual

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is about 12 milligrams, of which about five milligrams comes from the vessels in which his food is cooked. There has been some dissatisfaction expressed with the current Treasury Department standard for water supplies which establishes a maximum **zinc** content of 5 parts per million. Waters in the Missouri-Kansas-Oklahoma zinc district were found to contain up to 50 parts per million of the metal. From their studies, however, Bartow and Weigle[51] conclude that the current standard is reasonable and recommend adherence to the standard of 5 parts per million as the maximum permitted zinc content.

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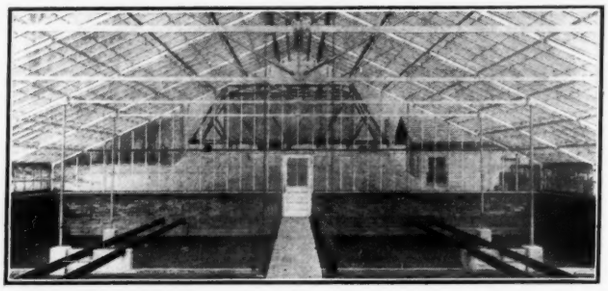

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Activated Carbon Treatment of Water

(Continued from page 21)

for removing phenolic and other taste-producing substances in Ohio river water was recommended by the Ohio River Board of Engineers. At least 180 cities now use this treatment, either regularly or as an emergency remedy of occasional tastes.

Apparently this use of pulverized carbon is practicable only for plants which are provided with filters for removing the carbon after it has performed its function; although it has been suggested as possible that it could be removed by sedimentation, aided perhaps by coagulation.

Method of Applying the Carbon

The carbon has been applied in some plants to the raw water, in others to the coagulation basins, or to the influent water as it enters the filter, and at least two plants mix it with alum or other chemical used and feed the two combined by means of a dry feed machine. Experience seems to indicate that the best point of application is the mixing chamber of a secondary coagulation basin, where secondary mixing is used. At Daytona Beach, Fla., the carbon is applied to the alum solution tanks and fed to the water entering the down-take in the softener, the effluent of which passes to pressure filters. This removes the characteristic flat taste from the heavily softened water by the lime-soda process. (This, incidentally, is the first softening plant in the country to use activated

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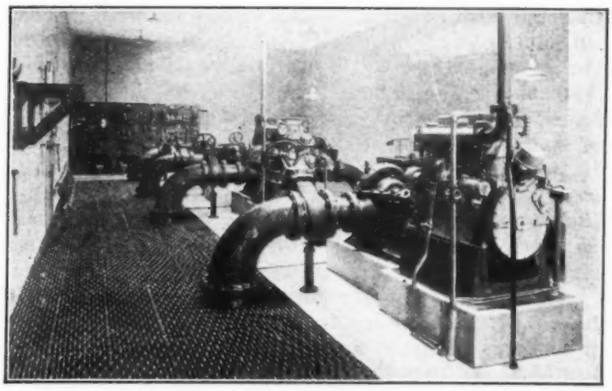

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carbon to remove the characteristic tastes that result in water softening plants that do not have recarbonation units to give them a balanced water.)

The most important requirement is that there be a thorough mixing of the carbon with all the water and that it remain so diffused for a time sufficient to permit the adsorption of all the undesirable substances in solution in the water. How long this period should be in a given case will probably depend upon the nature of the objectionable substance and the pH and other characteristics and contents of the water, and should be determined by trial for each case. This requirement would indicate not applying it until after coagulation (if used) and sedimentation have produced most of the clarification, or else sufficiently in advance of them to permit the carbon to complete its function before sedimentation begins.

In some plants where considerable carbon is carried down with the sludge in the secondary coagulation basin, this sludge is pumped back and applied to the water as it enters the primary coagulation basin, the carbon thus being given two opportunities to satisfy its adsorption capacity and so give more efficient service. No attempt is made to reactivate powdered carbon.

An incidental advantage which activated carbon furnishes when precipitated with coagulated sludge is that it continues to operate in the sludge and prevents it from imparting taste and odor to the overlying water; for which reason it is not necessary to remove the sludge as often as would otherwise be necessary.

The carbon may be applied in any way which will insure a thorough mixing of this pulverized material with the water. At present probably the most popular method is passing it through a dry feed machine and dispersing it in the water by means of a water ejector. Or it may be mixed with a small amount of water and this "solution" applied, but in such case the water in the solution tank must be kept agitated to prevent the settling out of the carbon.

Where the carbon is not precipitated before reaching the filter, it is deposited on or near the surface of the filter and may slow up its action by partially filling the pores. This may necessitate more frequent cleaning of the filter, or at least a breaking of the surface mat by applying just enough wash water to lift the surface slightly and then shutting off the wash and renewing filtering. Some plants find no decrease in length of filter run due to use of carbon; others report a decrease of ten to sixty per cent; and one, at least, found the length of filter run increased, presumably by effecting more complete alum coagulation.

The amounts of carbon used have varied from 0.25 p. p. m. to 20 or more. Probably 2 p. p. m. is an approximate average of ordinary practice, and this or less amounts seem to produce little or no clogging of the filters. For severe algae or stagnation tastes or for reducing residual chlorine, 5 to 10 p. p. m. (41.5 to 83 pounds per million gallons) is generally sufficient.

Since little or no additional equipment or changes in the plant are needed for using powdered activated carbon, it is especially applicable to emergency use when floods, reservoir overturn, algae growths, phenol discharges or other temporary causes of tastes, require special treatment.

Specifications for Activated Carbon

Until quite recently the pulverized activated carbon used by municipal plants has been furnished by one company (Nuchar, by the Industrial Chemical Sales Co.) and the filter carbon also by one company (Hydrodarco, by the Darco Sales Co.). There has therefore been no special object in specifying the characteristics desired for the activated carbon purchased; nor, in fact, is very much known about just what is desirable. But with rapidly increasing use and competition, it is very desirable that this matter be investigated.

The adsorptive capacity per dollar of cost is perhaps the most important. But it is also desirable to have such specific gravity that the pulverized material may remain in suspension as long as necessary to complete its function, but no longer, or high specific gravity so that granular carbon used as filter material will not be carried away with the wash water when washing the filter. John R. Baylis recommends the use of phenol for testing adsorptive capacity, with the following procedure: "Add various amounts of phenol to one-liter samples of water, then add 1-gram samples of the carbon. (With a machine that has six stirrers, six samples with varying amounts of phenol may be stirred at the same time.) The carbon is pulverized to pass a 200-mesh sieve before adding to the solution. The mixture is usually stirred for four hours, filtered through paper, and the solutions tested for the amount of phenol remaining in solution."

From a one-liter sample containing 5 milligrams of phenol, a gram of a good grade of commercial activated carbon should adsorb, at 20° to 25° C., all but 0.005 milligram or less; applied to a sample containing 15 milligrams of phenol, a gram of carbon should leave only 0.200 milligram in the solution.

Cost of Treatment

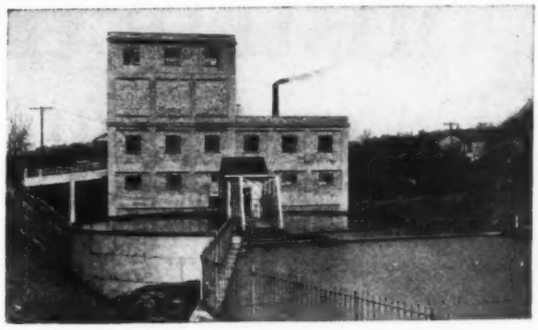
The cost of powdered activated carbon in 75-pound bags, is 5 cents a pound in carload lots. Therefore the material would cost 84 cents a million gallons for 2 p. p. m. application and $4.17 for 10 p. p. m. The cost of equipment is inconsiderable; in many plants a dry feeder and ejector are already on hand. If the use of the carbon necessitates more frequent filter washing, the cost of the additional wash water must be considered also. In many plants the carbon would be used only during the few days or weeks of the year when tastes become noticeable in the water, and for such plants the use of the powdered form is indicated.

The use of activated carbon as a filter material is more expensive in first cost, but requires little if any renewal of material, and is therefore recommended for plants where the use would be continuous or for a large part of the time. Bay City, Mich., replaced the sand in one of its existing filter beds of 700 square feet area with Hydrodarco carbon two feet deep, for treating a 5 m. g. d. supply, the total cost of the installation being $5,600.

Further Detailed Conclusions

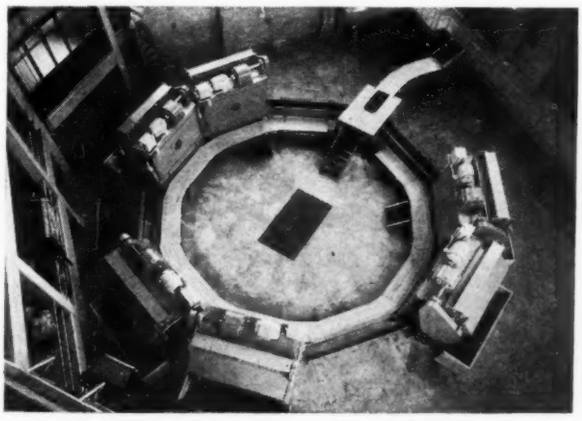
Detailed conclusions from investigations of ammonia-chlorine and activated carbon treatments, and special or unconfirmed findings by individual users, will be given in the next issue.

Sanitary Engineering



Unusual Design for Waterworks Screen House

The department of Water Supply of Detroit, in connection with the extensive development program which it is carrying out, designed an unusual screen layout. Ten vertical screens are arranged uniformly



Bird's-eye view from upper gallery of screen house, showing six screens, with spaces for four more.

to form the perimeter of a regular decagon, the bottoms of the screens submerged in a cylindrical chamber into which the raw river water is admitted, while the tops of the screens extend above the operating floor and discharge the screenings into a refuse trough located just inside the screen units, which trough drains in two directions to a run-off pipe.

The water, after passing through the screens, flows downward through a 14-foot opening in the center of the well, thence by gravity through a tunnel about ten miles to a new pumping station. This construction is said to have reduced the cost of screen chamber and housing and provided an excellent effluent connection with the new tunnel. The screen house was built high enough to permit removal of the entire screen units by overhead cranes.

The screens (of which only six are being installed at present) are "Clean-Water" type screens, 8′ 0″ wide overlapping trays covered by No. 10 gauge copper wire cloth having ⅜″ square openings. Guideways were provided for four future units, and stop logs inserted for the present. To prolong the life of screens to a maximum, several very advanced features of design were incorporated in the wearing parts, one of the most important being the use of stainless steel pins, rollers and bushings in the chains to resist the destructive effect of alternate submerged and atmospheric corrosion. Side bars are ½″ thick with oil broached holes for receiving pins and bushings. The screens were furnished by the Link Belt Company after designs of the department engineers.

Crematory for Small Animals

The disposal of the bodies of four-footed "hit and run" victims by cremation is now being successfully carried out by a number of small cities in California. The accompanying photo shows the crematory in operation at the city pound in Redwood City.

This crematory will cremate as much as 200 pounds of dogs or cats in approximately 40 minutes, no smoke being visible and no odor being detected. It is built of brick, a fire brick lining 9 inches thick, separated by a three-inch air space from the outside wall. The gas burner is so designed that the gas flame spreads into the combustion chamber so as to form a sheet of flame over the body. The heated air is taken from the air space between the walls by means of a motor-driven fan and introduced into the combustion chamber in such a manner that a high temperature is obtained with very small consumption of gas, and the cremation process is carried on quickly and with no objectionable odor. The cost of gas for cremating each animal averages approximately six cents.

Construction News

City
County

Department

State
U. S. Gov.

★★ *A Regular Monthly Feature of PUBLIC WORKS* ★★

Bids Wanted:

Streets and Roads

Ind., Indianapolis— 10 a. m., May 9
For improv. Michigan St., Gladstone Ave., and Third alley E. and E. St. from so. property line of Morris St.—Dept. of Pub. Wks., Indianapolis.

Ind., Jefferson— 10 a. m., May 7
Constr. of Charles C. Conway et al rd.—O. B. Fifer, Aud., Clark Co. Court House.

Ia., Council Bluffs— 7:30 p. m., May 9
Pav., curb. and gutter.—Wm. Guilfoyle, Clk., City Hall.

Kans., Olathe— 9 a. m., May 13
Port. cem. or E. C. pav. 4.912 mi. Johnson Co.—Co. Clk., Court House.

Ky., Frankfort— 2 p. m., May 11
Surfac. type constr. 105.15 mi. abt. 13 co. rds.—State Hwy. Dept., Div. of Construction.

Ky., Frankfort— 2 p. m., May 18
Grad. and drain. type constr. 1.5 mi. Bardstown-Hodgenville (U. S. 31-E), Nelson Co.—State Hwy. Comn. of Ky., Frankfort.

Md., Baltimore— May 10
Conc. shldrs. 7.94 mi. Allegany, Anne Arundel and Prince George's Co.; mac. surfac. 0.92 mi. Washington Co.—State Roads Comn., G. Clinton Uhl, Chmn., Federal Reserve Bldg., Balto.

Mich., Bessemer— 2 p. m., May 6
For tar mac. surfac. ½ mi. Yale-Colby location, grad. and drain. struct. 3 mi. Cheney Lake Rd.—Co. Hwy. Dept., George W. Koronski, Co. Hwy. Engr., Bessemer.

Mich., Ontonagon— 10 a. m., May 6
Cr. gravel, stamp sand or cr. rk. surfac. 3 co. rds.—Co. Rd. Comn., Edward Erickson, Chrm., Court House.

Minn., Argyle— 2 p. m., May 10
Grad. bet. Secs. 33-34; Sec. 27-27, secs. 15-16.—Frank Labine, Twp. Clk., Twp. Hall.

Minn., Buffalo— 1:30 p. m., May 10
Gravel. 10 mi. S. A. R. No. 8, Buffalo to Rockford.—Ernest R. Jude, Co. Hwy. Engr., Co. Hwy. Comn.

Minn., Duluth— May 12
Grad., and gravel. 18.20 mi. var. co. rds.—St. Louis Co. Commrs., Court House.

Minn., Elk River— 2 p. m., May 5
Grad. Job 3201, 3202 and 3203.—Charles S. Wheaton, Jr., Aud., Sherburne Co. Court House.

Minn., Granite Falls— May 23
Regravel. state aid rds. No. 11, 3, 18, 2, 26, and 8; gravel. co. aid rds. 14 and 7.—G. H. Wilson, Aud., Yellow Medicine Co. Court House.

Minn., Jackson— 2 p. m., May 10
Grad. and gravel. 38.95 mi. 6 Co. Aid Rds.—W. M. Richmond, Co. Hwy. Engr., Jackson Co. Court House.

Minn., St. Paul— 10 a. m., May 17
Grad. 59.50 mi., gravel. 16.2 mi. shldring. 8.7 mi., guard rail 403,000 ft.—Dept. of Hwys., C. M. Babcock, Comr., 1243 University Ave., St. Paul.

Minn., St. Peter— 10 a. m., May 9
Grad. 29 mi. 5 Co. aid rds.—W. H. Holz, Aud., Nicolet Co. Court House.

Minn., Thief River Falls— May 17
Gravel. state aid rds. abt. 11 mi.—H. L. Fowler, Aud., Pennington Co. Court House.

Minn., Walter— 2 p. m., May 10
Constr. 7.0 mi. S. A. R. 8, Cass Co.—Co. Cmrs., A. A. Cater, Co. Aud., Court House.

Minn., Willmar— 2 p. m., May 11
Gravel. 66.8 mi. Trunk Hwys. 4, 22, 70.—C. M. Babcock, Comr. of Hwys., Dist. office Hwy. Dept., Willmar.

Minn., Worthington— 1 p. m., May 12
Grad. and gravel. 45 mi. Co. aid rds.—C. J. Kail, Aud., Nobles Co. Court House (H. R. Bray, Co. Enr.).

To be of value this matter must be printed in the number immediately following its receipt, which makes it impossible for us to verify it all. Our sources of information are believed to be reliable, but we cannot guarantee the correctness of all items. Parties in charge of proposed work are requested to send us information regarding it as soon as possible, also corrections of any errors discovered.

Mo., Jefferson City— 10 a. m., May 5
Conc. pav. 47.108 mi. in var. cos.; gravel. 63.019 mi. var. co., and chats 13.777 mi. co. rds.—Mo. State Hwy. Comn., Secretary, State Hwy. Bldg. (T. H. Cutler, Chief Engr., Jefferson City, Mo.).

Mo., St. Louis— May 10
Asph. on conc. pav. Market St. and rein. conc. pav. driveways in front of Union Sta. est. cost $28,444.—Bd. Pub. Serv., City Hall.

N. Y., Scarsdale— May 10
Constr. trunk and lateral sews. in Sewer Dist. No. 2.—Village Engr., Village Hall, Post. Rd. nr. Popham Rd.

N. D., Harvey— 7:30 p. m., May 9
Pav. in Dist. No. 1—State Hwy. Dept., H. C. Frahm, Sec., Bismarck (T. R. Atkinson, Engr., Bismarck).

O., Chillicothe— 12 m., May 11
Oil and surfac. with oil and bit. matl. several sts. in city.—Alphonse Muller, Ser. Dir.

O., Cincinnati— May 5
Street improvmts. Columbia Ave.—H. F. Shipley, Hwy. Engr.

O., Columbus— May 6
Grad., drain. brk. pav., tar mac. pav., conc. pav. 32.368 mi. var. co. rds.; est. cost $1,004,628. State Hwy. Dept., O. W. Merrell, Hwy. Dir., Columbus.

O., Elyria— May 10
Improv. Hill Ditch, Avon Lake.—Co. Comrs., Co. Engr. C. T. Biggs.

O., Fostoria— 12 m., May 7
Waterbound. mac. 1 mi. rd. Dewald Twp.—Loudon Twp. Trustees, Harry L. Stultz, Clk.

O., Hamilton— 10 a. m., May 6
Bldg. and reconstr. Trenton-Franklin Rd. No. 81-D, from W. Middletown to Poasttown.—A. F. Boli, Clk., Co. Comrs. (W. S. Conklin, Co. Engr.).

O., Hamilton— 11 a. m., May 10
Making rd. cut on Darrtown Rd. No. 227-B, Milford Twp., Sec. 33.—Bd. of Comrs. of Butler Co., A. F. Boli, Clk., Court House.

O., Newark— 12 m., May 6
Constr. conc. curb. and gutter, etc., at Cedar Hill Cemetery.—Guy W. Lawyer, Ser. Dir., City Hall (Chas. Wells, City Engr.).

O., Wooster— 1 p. m., May 5
Improv. Eby Ditch, Paint Twp.—Co. Comrs., O. G. Leapley, Co. Engr.

Pa., Harrisburg— 10 a. m., May 6
Bit. surfac. course, one course reinf. conc., modified broken stone base course, pav. 257,109 ft. Erie, Forest, Elk, Fulton, Greene, Lackawanna, McKean, Wayne Cos.—Dept. of Hwys., S. S. Lewis, Secy., Room 506, North Office Bldg., State Capitol, Harrisburg.

S. D., Sioux Falls— 9:30 a. m., May 9
Grad. and pav. Euclid Ave., Minnesota Ave.—Walter C. Leyse, Aud., City Hall.

S. D., Sioux Falls— May 16
Constr. curb. on Minnesota Ave. (NOTE CHANGE IN DATE.)—Walter C. Leyse, Aud.

Va., Petersburg— May 6
For 7 mi. earth rd. in Petersburg Natl. Military Pk.—War Dept., Petersburg Natl. Military Pk. Comsn.

Wis., Chippewa Falls— 1 a. m., May 9
Curb. and gutter.—Lee C. Millard, City Clk. (S. R. Cray, City Engr.).

Wis., Fort Atkinson— May 17
Widen. No. approach to Wilcox Bridge.—Edw. Hedberg, Clk., City Hall.

Wis., Lancaster— 10 a. m., May 6
Gravel. and cr. rk. surfac. 2,670. mi. var. co. rds.; furn. 2,670,000 gals. tar type, asph. type bit. matl.; apply 2,036,000 gals. bit. matl. on co. rds.—Wis. Hwy. Commn., Lancaster.

Wis., Madison— 3 p. m., May 10
Pav. Iroquois Dr.; Country Club Rd.; alley in Blk. 1.—John W. Fahning, Clk. (E. E. Parker, City Engr.).

Wis., Milwaukee— 2 p. m., May 12
Constr. State Trunk Hwys.—Wm. F. Cavanaugh, Milwaukee Co. Court House.

Sewerage & Sanitation

Md., Baltimore— May 11
Constr. incinerator plant capy. 9,000 tons, nr. Brooklyn (Miles' Flats), Balto.—Dept. of Pub. Wks., Bureau of Mechanical Electric Service, W. Raynor Strauss.

Mich., Monroe— May 9
Constr. 24 in. sew., 18 in., 12 in., 10 in., etc., on No. Monroe St.; est. cost $20,000.—Stuart M. Weaver, City Engr.

N. Y., New Paltz— May 10
For constr. sews. and water lines at Practice School.—Dept. Education, State Office Bldg., Albany.

O., Norwalk— May 7
Constr. sewage disposal plant on Old Plank Rd. 1 mi. no. of city; est. cost $200,000.—City Engr., City Hall.

Wis., Appleton— 2 p. m., May 6
For constr. sani. sew. in Pierce St., from Front St. So. 320 ft.—Carl J. Becher, Clk. (E. H. Bass, City Engr.).

Wis., Madison— 3 p. m., May 10
Constr. sani. sews. in var. rds., places throughout Madison.—Nakoma Sewer Dist., John W. Fahning, Clk. (E. E. Parker, City Engr.).

Water Supply

Neb., Friend— 1:30 p. m., May 5
Drill wells and furn. two deep well turbine pumps, incl. install. same, valves, pipe and appurts.—Grace A. Dreher, Clk., City Hall.

N. Y., West Haverstraw— May 10
Constr. new well for Reconstr. Home.—Dept. Health, State Office Bldg., Albany.

N. D., Williston— 8 p. m., May 9
Constr. water works improvmts. includg. bldg. and structs., filter equipment, sludge remov. equipment, pumps and elect. equipment.—Bd. of Commrs., H. T. Shovholt, Pres., Chamber of Bd., City Hall Bldg.

O., Columbus— 10 a. m., May 7
Lay. water mains, Sew. Distr. Mifflin No. 1, Impr. No. 159, also nec. gate valves, fire hydrants, etc.—Co. Comrs., Fred L. Donnally, Clk.

O., Miamisburg— 12 m., May 6
Constr. one large diameter well, one 700 gal. per minute pump, one pump house complete and one water meter; also one compensator for 60 horsepower motor; and furn. 2,800 ft. 10 in. class "B" cast iron pipe.—C. A. Hamilton, Ser. Dir., 806-7 Union Trust Bldg., Dayton, O. (Collins Wight, Village Engr., Dayton, O.).

Pa., Harrisburg— 10:30 a. m., May 13
Lay. 8 in. water pipe in Fifth St. from Graham to Antoine Sts.—Dept. of Pub. Safety, Samuel F. Hassler, Dir., Room 214, City Hall.

Wis., Oshkosh— 2 p. m., May 6
Lay. water mains in abt. 7 sts.; and constr. walls at Water Works Filtration Plant.—Bd. Pub. Wks., A. H. Schmitt, Secy. (G. H. Randall, City Engr.).

Wis., Watertown— 7:30 p. m., May 9
Lay water mains in Utah St.—Water Wks., Commn., Ferd. Schmutzler, Secy.

Bridges

Ill., Springfield— **May 10**
Constr. substruct. for Smith's Hwy. Br. at Channahon, Cont. B-7.—Dept. Purchases and Constr.

Ind., Indianapolis— **10 a. m., May 10**
Constr. Br. Cont. 501, over White River, Marion Co.—Indiana State Hwy. Comn., Div. of Constr. Brs., J. J. Brown, Dir., State House Annex.

Ky., Frankfort— **2 p. m., May 18**
Constr. rein. conc. substruct. for br. over Beech Fork River, and steel superstruct. with conc. floor for same br. Nelson Co.—State Hwy. Comn. of Ky., Frankfort.

Md., Baltimore— **May 10**
Constr. triple span steel girder br. with conc. floor over Youghiogheny River at Friendsville, Garrett Co.; conc. br. floor and surfac. on approaches for br. over Monocacy River, Frederick Co.—State Roads Comn., G. Clinton Uhl, Chmn., Federal Reserve Bank Bldg.

Mich., Lansing— **2 p. m., May 11**
Constr. br. on U. S. 31, crossing Manistee River in Sect. 1, Manistee Co.—Contr. No. 3.—State Hwy. Dept., Chief Engr., Lansing.

Minn., Duluth— **May 12**
Constr. Br. Co. Rd. 22.—Co. Aud., St. Louis Co. Court House.

Minn., Meriden— **8:30 p. m., May 5**
Constr. br. 15 ft. span.—William Vess, Chrmn., Meriden Twp. Hall.

Minn., Worthington— **1 p. m., May 12**
Constr. br. and culvts.—C. J. Kall, Aud., Nobles Co. Court House (H. R. Bray, Co. Engr.).

Mo., Jefferson City— **10 a. m., May 5**
Constr. bridges in var. cos.—Mo. State Hwy. Comn., Secretary of Comn., State Hwy. Bldg (T. H. Cutler, Chief Engr., Jefferson City).

N. J., Atlantic City— **May 15**
Constr. br. in the span of 4 connect. Ocean City with Somers Point.—State Hwy. Comn., Trenton.

N. J., Trenton— **11 a. m., May 18**
Constr. br. over each Thorofare at Ninth St., Ocean City, Cape May Co.—New Jersey State Highway Comn., A. Lee Grover, Chief Clk., State House Annex, Trenton.

O., Columbus— **10 a. m., May 25**
Extend. culvts. No. 103 and 104. on Eachus Rd. No. 262, Jackson Twp.—Co. Comrs., Fred. L. Donnally, Clk. (Curtis C. Lattimer, Co. Engr.).

O., Dayton— **10 a. m., May 7**
Constr. superstruct. Br. No. 31.—Co. Comrs., F. A. Kilmer, Clk.

O., Findlay— **1:15 p. m., May 16**
Constr. Br. No. 10-31, Eagle Twp.—Gale B. Clymer, Clk., Co. Comrs. (A. P. MacGregor, Co. Engr.).

O., Ravenna— **12 m., May 16**
Constr. and furn. matl. for bridges.—H. L. Hubbel, Co. Engr., Co. Comrs.

O., Sidney— **10 a. m., May 19**
Constr. Br. No. 19, Rd. 85, Turtle Creek Twp.; and Br. No. 31, Rd. 22, Dinsmere Twp.—Co. Comrs., L. H. Harman, Clk. (Ed. Maurer, Co. Engr.).

Pa., Harrisburg— **10 a. m., May 6**
Constr. rein. conc. arch br. box culvts. 14, Erie, Forest-Elk, Fulton, Greene, Lackawanna, Wayne Cos.—Dept. of Hwys., S. S. Lewis, Secy., North Office Bldg., State Capitol.

Vt., Montpelier— **10 a. m., May 13**
Constr. Pittsfield Br., F. A. Proj. 101-C, over Tweed River.—Dept. of Hwys., H. E. Sargent, Comr., State House.

Wis., Racine— **2 p. m., May 5**
Constr. br. on co. trk. "X" nr. Waterford.—Co. Hwy. Comm., Court House, Racine, E. R. Fischer, Co. Hwy. Commr.

Drainage & Irrigation

Del., Wilmington— **2 p. m., May 27**
Dredg. and furn. matl. 107,000 cu. yds. of matl. in Inland Waterway from Delaware River to Chesapeake Bay, Del. and Md.—U. S. Engr. Office, Wilmington, Del.

Mich., Holland Harbor— **3 p. m., May 18**
Dredg. new 18 ft. channel, 2⅞ mi. long, Black Lake; est. cost $65,000.—U. S. Engr. Office, 408 Federal Bldg., Milwaukee, Wis.

R. I., Providence— **2 p. m., May 13**
Dredg. 24,900 cu. yds. matl. and remov. abt. 18,436 cu. yds. ledge rk. in Taunton River, Mass.—U. S. Engr. Office.

R. I., Providence— **2 p. m., May 20**
Dredg. 467,000 cu. yds. matl. in Bridgeport Harbor, Conn.—U. S. Engr. Office, Providence.

Wis., Milwaukee— **3 p. m., May 18**
For dredg. in Black Lake, at Holland Mich.—U. S. Engr. Office, Milwaukee, Wis.

Miscellaneous

Ill., Chicago— **May 11**
Constr. 1,150 ft. earth levee, contain. 5,300 cu. yds. earth embankmt. bet. Illinois and Michigan Canal and Ill. Traction Sys. right-of-way.—U. S. Engr. 1st Chicago Dist., 333 No. Michigan Ave., Chicago.

Miss., Vicksburg— **10 a. m., May 17**
Constr. 23 items of earthwk. ranging from 185,000 to 1,193,000 cu. yds. on E. and W. banks of Mississippi River in Miss., Ark. and La.—U. S. Engr. Office, P. O. Box 667.

Va., Petersburg— **May 6**
Constr. 2 mi. earthwk. in Petersburg National Military Park, Va.—War Dept., Petersburg National Military Park Comsn.

Contemplated Work

Streets and Roads

Ill., Galena—Will call bids soon for conc. pav. on Prospect and Hill Sts.—Marr, Green & Opper, Ind., Engrs., 400 No. Michigan Ave., Chicago, Ill.

Minn., St. Paul—Will take bids in Summer for pav. and widen. University Ave. bet. Dale St.-Park.; est. cost. $210,000.—Milton Rosen, Comsr. of Pub. Wks.

Minn., St. Paul—Will take bids in spring for pav. Snelling Ave. bet. Minnehaha St.-N. P. Trks.—Milton Rosen, Comr. of Pub. Wks.

Minn., White Bear—Bids abt. May 10 for abt. 5 blks. of surfac. prob. cut-back asph.—A. Holzheid, City Mgr., City Hall.

Mont., Butte—Will call bids soon for conc. surfac. 11 curves on Butte-Anaconda Hwy.—State Hwy. Comsn., R. D. Rader, State Hwy. Engr., Helena.

Mont., Butte—Ready for bids soon, pav. on Front St. from Harrison Ave.-Montana St., est. cost $35,000.—James J. Harrington, Clk., Silver Bow Co., Court House.

N. Y., Albany—Bids abt. July, for conc. pav. 5 mi. Verona Station-State Br. Hwy., Oneida Co.; est. cost $270,000.—Dept. Pub. Wks., A. W. Brandt, Comr. Hwys. Div. of Hwys., State Office Bldg.

O., Bluffton—Contr. to be let abt. June 1 for widen. Dixie Hwy. from Findlay to Allen-Hancock Co. line; total cost $225,000.—State Hwy. Dept., O. W. Merrell, Dir., Columbus.

O., Canton—Bids abt. July, for repav. widen., constr. sews., 1 mi. Tuscarawas St.; est. cost $124,364.—Bd. Control (J. Shisler, Engr., City Hall).

Wis., Berlin—Bd. Pub. Wks., author. to adv. for bids for rein. conc. pav. on Market Square Park Ave.—City Council, City Hall.

Wis., Hurley—Bids after May 15th. Grad. 20 mi. Birch-Ironwood Rd., Iron Co.; est. cost $190,000.—Co. Hwy. Comn., Angus J. Lamont, Co. Hwy. Commr., Hurley.

Wis., Wausau—Plans completed for conc. and grad. 5.5 mi. Antigo-Hogarty Rd.; est. cost $170,564.—Co. Hwy. Comn., J. A. Clark, Co. Hwy. Comr., Wausau.

Sewerage & Sanitation

S. D., Sioux Falls—Contemp. for late this fall, constr. sewage disposal plant improvmts.; est. cost $150,000.—Walter E. Leyse, Aud. (Pillsbury Engr. Co., Engr., 1200 2nd Ave. S., Mpls., Minn.).

O., Newark—Service Dir. authorized to adv. for bids for labor and matl. for sew. on Manning St.

Water Supply

N. Y., New York City—Bids abt. Sept. 15 genl. contract for pump. sta., Amsterdam Ave. and 179th St.; est. cost $250,000.—Dept. Water Supply, Gas & Elec., Municipal Bldg., J. J. Dietz, Comr.

Wis., Oshkosh—Bd. of Public Works authorized to call bids for lay. water mains in var. sts.—(G. H. Randall, City Engr.)

Bridges

Ill., Seneca—Bids abt. May 10 for constr. br. across Illinois River.—M. J. Fleming, State Dist. Engr., Ottawa.

Wis., Appleton—Will call bids soon, for constr. Flanagan Br., Maple Creek on Trk. "D", Outagamie Co.—Co. Hwy. Comn., F. R. Appleton, Co. Hwy. Commr., Appleton (D. F. Culbertson, State Div. Engr., Green Bay, Wis.).

Official Advertising

STATE DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS
ALBANY, N. Y.

Sealed proposals will be received by the undersigned at the State Office Building, 13th Floor, Albany, N. Y., until one o'clock p. m., advanced standard time, which is twelve o'clock noon eastern standard time, on Tuesday, May 10, 1932, for the construction of highways in the following Counties:

County	Deposit Required
ORANGE (Concrete: 8.62 Mi.)	$16,000.00

Also for the reconstruction of the following:

HAMILTON (50′ 1-beam Bridge) (Grading approach 0.08)	800.00
NASSAU (Completion) (Concrete: 3.58)	15,000.00
ONEIDA (Cons. & Recons.) (Concrete: 4.10)	11,000.00
STEUBEN (70′ & 75′ Plate Girders) (Bit. Mac. M.M. Opt. Appr. 0.55)	5,000.00
SULLIVAN & ORANGE (Concrete: 1.70)	7,000.00
WESTCHESTER (Concrete: 2.42)	18,000.00

Maps, plans, specifications, and estimates may be seen and proposal forms obtained at the office of the Department in Albany, N. Y., and also at the office of the District Engineers in whose district the roads are located, upon the payment of Five Dollars ($5.00) for plans and proposal forms. Standard specifications are Two Dollars ($2.00) per copy. Refund will not be made on plans, proposal forms or specifications. The addresses of the District Engineers and the counties in each district will be furnished upon request.

The especial attention of bidders is called to "General Information for Bidders" in the itemized proposal, specifications, and contract agreement.

A. W. BRANDT,
Commissioner of Highways.

STATE DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS
ALBANY, N. Y.

Sealed proposals will be received by the undersigned at the State Office Building, 13th Floor, Albany, N. Y., until one o'clock p. m. on Tuesday, May 3, 1932, advanced standard time, which is twelve o'clock noon eastern standard time, for the improvement of highways in the following Counties:

County	Deposit Required
CAYUGA (Two highways: 7.31 & 4.06 Mi.)	$12,500.00 & $7,000.00
CHEMUNG & SCHUYLER (One highway: 8.94 Mi.)	22,000.00
DUTCHESS (Cons. & Recons. One highway: 6.79 Mi.)	21,000.00
LIVINGSTON (One highway: 5.85 Mi.)	15,000.00
MONTGOMERY & SCHOHARIE Cons. & Recon. one highway: 8.73 Mi.)	15,000.00
STEUBEN (One highway: 8.80 Mi.)	21,000.00

ALSO FOR THE RECONSTRUCTION OF THE FOLLOWING:

ALBANY (One contract: 1.66 Mi.)	12,000.00

Maps, plans, specifications, and estimates may be seen and proposal forms obtained at the office of the Department in Albany, N. Y., and also at the office of the District Engineers in whose district the roads are located, upon the payment of Five Dollars ($5.00) for plans and proposal forms. Standard specifications are Two Dollars ($2.00) per copy. Refund will not be made on plans, specifications or proposal forms. The addresses of the District Engineers and the counties in each district will be furnished upon request.

The especial attention of bidders is called to "General Information for Bidders" in the itemized proposal, specifications, and contract agreement.

A. W. BRANDT,
Commissioner of Highways.

HITCHINGS
SUPER-FRAME
GLASS COVERS
For Sludge Drying Beds and Spray Houses.

Engineers' Folder giving plans and specifications gladly sent on request.

Hitchings & Company
General Offices and Factory: Elizabeth, N. J.

DAYTON-DOWD
CENTRIFUGAL PUMPS
FOR
Waterworks and Filtration Plants
Sewage Disposal Plants
Sewage Relift Stations
Designed and built by Centrifugal pump specialists of long experience
MANUFACTURED BY
DAYTON-DOWD COMPANY, Inc.
WORKS—QUINCY, ILLINOIS
SALES OFFICES IN 51 CITIES

STREET, SEWER AND WATER CASTINGS
Made of wear-resisting chilled iron in various styles, sizes and weights.

MANHOLE COVERS
WATER METER COVERS
ADJUSTABLE CURB INLETS
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Winter Development of Algae

Development of algae in a reservoir is sufficiently annoying when it occurs in summer, when proper and timely use of copper sulphate can generally prevent development or destroy the algae. But northern cities are occasionally plagued with algae development in winter when the reservoirs are covered with ice. Referring to this, the New Hampshire state board of health says: "At this season there is usually nothing to do but to tolerate it and to hope for an early abatement, the condition as a rule being of rather short duration. Fortunately, no deleterious quality is imparted to the water in this way. A condition favoring development is one of low water followed by a prolonged rainy period.

"A severe case of winter algae development occurred in the Laconia supply some years ago, and there has also been some recent complaint. The organism chiefly responsible in this case seems to be uroglena. The latter was also found in the Wolfeboro supply in connection with a similar condition occurring here this winter.

"Since about January first the Concord supply has been unusually hard hit in this respect. In fact, nothing like it hitherto occurring can be recalled, this supply ordinarily not being open to this criticism in any substantial degree. The condition this winter is confined to the low pressure system, which is derived from Penacook Lake. Residents on the higher elevations of this city, supplied from the new well system—a water of high excellence—have been fortunate in escaping this annoyance. Cases are known to us of drinking water being carried from this section by householders situated on the lower levels.

"The factor inducing the Concord condition was the extreme low level of the water in Penacook Lake and the exceptional rainfall during the past few weeks. The predominating organism occurring here was found to be what is known to the biologist as dinobryon."

Placing the Woonsocket Activated Sludge Plant in Operation

(Continued from page 27)

Although not many analytical data are available at this time, some are included to show results obtained during the time the plant was placed in operation. The results given are from analyses made on 24-hour composite samples; the composite being made according to the rate of flow. The results for suspended solids in the aeration tanks are shown in table 1, the suspended solids in the effluent of the different units in table 2, and the B.O.D. of the effluents of different units in table 3.

The period June 8 to 15 inclusive was one of intense rainfall. In case of heavy rainfall with low river, the excess flow can usually be by-passed, but at this time the river rose to such a height that it was impossible. Consequently the rate of flow through the plant was great enough to wash out all the floc that had been accumulated. During the period of June 16 to 22 a new floc was established. It will be noticed that the primary settling tanks removed from 57% to 74.5% of the suspended solids, the greater removal being recorded when the screened sewage contained the greater amount of suspended solids.

The B.O.D. values show what may be expected from the treatment under adverse conditions. These samples, although composites, represent only one day each. It is of interest to note that the greatest reduction is during a period when the aeration tanks held only an average of 787 p.p.m. of suspended solids.

The air supply was practically the same during the entire period, namely 1.1 cu. ft. per gallon.

The cost data given in tables 4 and 5 are from figures taken for the month of March, 1931. The electrical calibrations were made by representatives of the Blackstone Valley Gas and Electric Co. The cost of power has been reduced somewhat and future data will vary from the present.

Acknowledgment

The writer is indebted to the help afforded by plant operator Edwin Marrah, by Joseph White, commissioner of public works, and the Roberts Filter Company, which installed the mechanical equipment. The offices of the engineers, Remington, Vosbury and Goff, were very helpful also.

The author also is indebted to Dr. W. Rudolfs for the help given in the preparation of the manuscript.

Supervision of Sewage Plants of State Institutions

"The sewage treatment plants of the state institutions, which for the past two years have been supervised regularly by an engineer from this Bureau, have shown clearly the efficiencies attainable by intelligent operation and the value of comparative observations by one engineer on varied types of plants."

In our issue of April, 1930, we noted, with hearty approval, the beginning of this supervision of institutional plants, and in the issue of May, and later ones, we published comments of others on the practice, which is by no means general. We are glad to learn, as stated above, that Maryland finds such supervisions well worth while.

Waste Disposal in Wisconsin

Assistance to canners in waste disposal problems was continued by the Wisconsin state board of health in 1931, and 27 treatment plants of the chemical precipitation type, based on research conducted by the board since 1926, were in operation during the past season among canneries of the state, as well as two plants using the broad irrigation method.

Research conducted at De Forest by the state board during the period of 1927-30 in milk plant waste treatment has been followed by installation of seven full-scale systems of the rock filter type during the past two years by various types of milk products factories.

Lime sludge pollution from pulp and paper mills operating the Kraft process is virtually ended in Wisconsin by use of recovery systems and settling ponds adopted through the activities of two committees representing the paper industry and the state.

Test methods of deodorizing and otherwise improving sulphate pulp mill effluents will continue this year, according to L. F. Warrick, state sanitary engineer, and use of ozone will be tried in experimental work directed toward a remedy for sulphate waste pollution, which 1931 experiments indicated as having a toxic effect on fish life as well as a capacity for depleting the dissolved oxygen supply in streams.

Stoking Room of the Dunbar Place (Eastern) Incinerator. Note the four mutual assistance cells in the furnace; the ease of stoking; the well lighted and ventilated working space; the sturdy reinforced construction and well built masonry.

Two 100-Ton 'PDM' Incinerators Help to Make Cincinnati a Cleaner City

Since 1924 the engineers and designers of the Pittsburgh-Des Moines Steel Company have been studying and improving the construction and operation of municipal incinerators. In these eight years, they have erected over 60 municipal garbage disposal plants throughout the country.

The "Pittsburgh-Des Moines" incinerator is simple to operate and almost "foolproof." *All dried garbage is utilized as fuel.* It operates efficiently and at low cost—with no smoke, no odors, and no fumes. In many cities "Pittsburgh-Des Moines" plants are located close to the business section or residence district with no complaints from odors or smoke. Modern design, scientific operation, and appropriate landscaping make the "Pittsburgh-Des Moines" plant a distinct civic improvement.

Get the facts **on scientific municipal incineration. The "Pittsburgh-Des Moines" catalog gives you 24 pages of operating cost data in various cities—and detailed descriptions of the construction and operating features of a modern incinerator plant.**

Exterior view of the Dunbar Place (Eastern) plant showing driveway and collection truck entrance. Note the modern building design and large diameter radial brick chimney. The western Cincinnati plant is located on Cleveshank Road.

Pittsburgh-Des Moines Steel Co.

3454 Neville Island Pittsburgh, Pa.

Room 942, 270 Broadway New York City, N. Y.

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1. In the ability to specify smaller pipes in construction due to assurance that the full capacity of pipe is always available by prevention of infiltration at joints.
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4. Trenches may be back filled at once as compound sets immediately.
5. Strong acids and alkalis, so much a part of sewerage, have no effect on EX-XL-CELL
6. Two or three joints may be poured outside of the trench, and lowered in trench as a unit thereby reducing labor in restricted space of trench.

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KEEPS ROADS DUSTLESS

Developments in Dirt Moving Equipment and Methods

Blaw-Knox Hydraulic Bulldozer

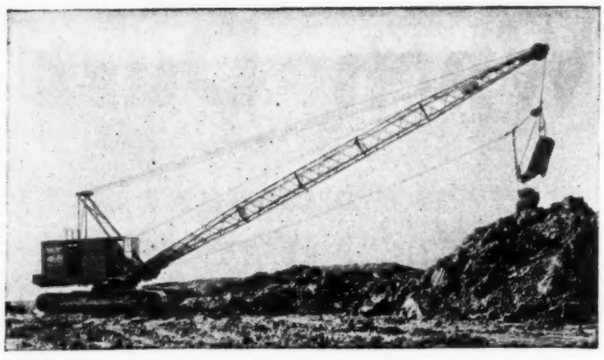
Blaw-Knox (Ateco) Hydraulic Bulldozer is made for attachment to all sizes of tractors. The power is enclosed in the side arms, fully protected from dust and dirt—reducing maintenance cost and preventing breakdowns. The Bulldozer bowl is curved, designed to lift and roll dirt, greatly reducing resistance to pushing. The cutting edge is made of alloy steel to give the greatest possible resistance to abrasion and to retain its sharp cutting edge. The bowl is electrically welded, heavily reinforced, supported by two side arms and attached to tractor truck frame.

The blades work within close limits of the tractor. No part of this framework extends beyond the rear of the tractor; the drawbar is left free and clear for the attachment of other equipment.

Control is by the tractor operator through a hydraulic pump, which with a single control holds the bowl with its cutting edge at any desired elevation.

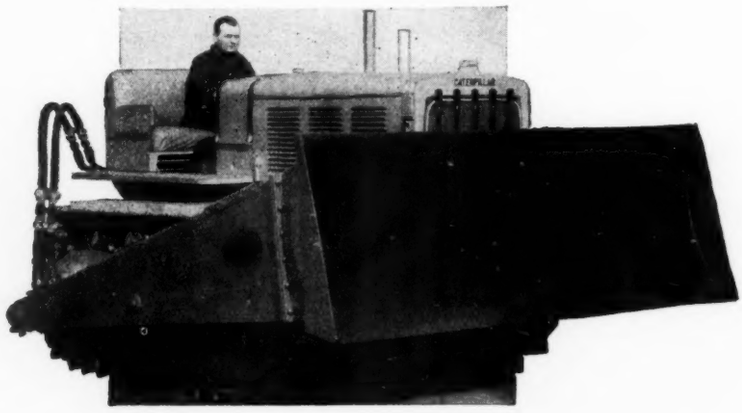
A New Bucyrus Dragline

The new 45-dragline recently introduced by Bucyrus-Erie is a a special machine for dragline work. One of its outstanding features is the long, tapered caterpillar-type mounting which enables it to work and cross soft ground easily and without nosing in. These cats are 19 feet 6 inches long and give lowest ground pressures, have high clearance under the frame, and propel easily even in heavy sticky mud.



The Bucyrus "45' Dragline at work.

The 45-B may be equipped with a 2 to 2¼-yard bucket (depending on the weight of the bucket, the material being handled, and the working radius) and 50-foot boom or a 1¼ to 1½-yard bucket on a 65-foot boom; booms may be had up to 80 feet long, of alloy steel. The machine steers. like a tractor, through clutches controlled by a lever at the operator's side, it makes sharp or gradual turns with the cab in any position. It is not convertible to a shovel though it may readily be used for clamshell or crane service. It is only necessary to remove boom and A-frame to ship on most U. S. railroads.



Blaw-Knox hydraulic bulldozer has new features.

Readers may obtain further information by writing to Bucyrus-Erie Co., South Milwaukee, Wis. and mentioning this magazine.

The Bulldozer is at home under a variety of conditions of hard work.

Increasing Dirt-Moving Efficiency With Bulldozers

By R. J. Morgan

The bulldozer has many uses in the dirt-moving field, such as moving dirt for short distances, spreading dirt dumped by wagons or trucks, spreading dirt in layers for succeeding compaction (as is required on dams, types of levee work and by many state highway departments), and to smooth the runways on which various types of hauling equipment is used.

The latter use is the most important and results in the three following advantages: 1. It enables larger loads to be hauled. 2. Allows higher speeds to be maintained, permitting more dirt to be delivered with the same equipment. 3. Reduces the maintenance cost on hauling equipment.

Herewith are shown some views of bulldozers in action. Above, the bulldozer is being used on levee work along the Mississippi to level a runway for the tractor and crawler wagons. Below, left, bulldozing a fill on a New Jersey highway. Right, clearing a road after a blast near Kensico, N. Y.

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★ *It is a good practice to check this list regularly because descriptions of new bulletins are always being added.*

Construction Materials and Equipment

Accessories for Motor Trucks

1. Truck accessories—winches, power take-offs, derricks, special bodies, earth boring machines, and trailers of all capacities. Dept. B, Four Wheel Drive Auto Company, Clintonville, Wisconsin.

Asphalt Heaters

8. A 32-page general catalog issued by Littleford Bros., 452 E. Pearl St., Cincinnati, Ohio, describes and illustrates their complete road maintenance line, including tar and asphalt kettles, surface heaters, oil burners, sand dryers, tool boxes, lead and compound furnaces, tool heaters, asphalt tools, joint and crack fillers, squeegee carts, etc.

9. Illustrated manual No. 11 describes "Hotstuff," the master oil burning heater. The only heater with patented elevated melting chamber for Asphalt, Tar and all bitumens used in road and street construction and maintenance, roofing, water proofing, pipe coating, etc. Mohawk Asphalt Heater Co., 94 Weaver St., Schenectady, N. Y.

Asphalt Plants

10. Portable Asphalt Paving Plants. These R. R. 1-car plants have easy capacity of 2,250 yards, 2" surface per 8 hours. Cheap to operate. J. D. Farasey Mfg. Company ,Cleveland, Ohio.

Asphalt Rollers

12. How to use Rollers to Save Tamping Costs. 16-page booklet gives details and also specifications of the Erie Roller. Issued by the Erie Machine Shops, Erie, Pa.

Bins and Hoppers

20. The Owen Bucket Company, Cleveland, Ohio, have available illustrated folders on Material Handling Buckets, showing the various types, sizes and uses for which they are intended and construction features and other valuable bucket information. A complete catalog on all types of Material Handling Buckets will also be furnished on request.

Bituminous Road Paver

25. Specifications and description of new Paver that gathers, proportions, mixes, spreads and compacts bituminous road in one continuous operation offered by Barber-Greene Co., 635 West Park Ave., Aurora, Ill. Ask for Bulletin BPF.

Clamshell Buckets

27. Clamshell Buckets, showing the various types, sizes and uses for which they are intended, and construction features and other valuable bucket information. A complete catalog on all types of Clamshell Buckets will also be furnished on request. The Owen Bucket Company, Cleveland, Ohio.

Concrete Accelerators

30. "How to Cure Concrete," a forty-seven page manual published by the Dow Chemical Company, Midland, Michigan, treats fully subjects suggested by title.

31. "Curing Concrete Roads with Solvay Calcium Chloride," 30 page booklet. Comprehensive. Contains tables, illustrations, suggestions for testing devices. Covers the subject in considerable detail. Solvay Sales Corp., 61 Broadway, N. Y. C.

35. "A report on Current Practice of using Calcium Chloride for curing Concrete Pavements, Bridges, Culverts and Concrete Products." It includes reports from the Highway Research Board, the Bureau of Public Roads and State Highway Departments. Columbia Products Co., Barberton, Ohio.

Concrete Handling

40. Pouring concrete with portable and permanent belt conveyors on bridges, dams, buildings, locks, sewers, tunnels, etc., is described in a generously illustrated booklet, "CONCRETE HANDLING," by Barber-Greene Co., 635 West Park Ave., Aurora, Ill.

Concrete Mixer

44. Concrete Mixers, both Tilting and Non-Tilting types, from 3½s to 84s size, The Jaeger Machine Company, Columbus, Ohio.

Crushers

57. Up-to-date information on Stone Crushers, Stone Spreaders, Unloaders, Drags and other contractors' equipment from the Galion Iron Works & Mfg. Co., E. Jeffry, Mfg. Co., Columbus, Ohio.

Excavating Buckets

73. Excavating Buckets — shows the various types and sizes, the uses for which they are intended, construction features and other valuable bucket information. A complete catalog on all types of Excavating Buckets will also be furnished on request. The Owen Bucket Company, Cleveland, Ohio.

Finishing Machines and Screeds

75. High Speed Screeding and Finishing—the use of single and tandem screeds and tamper attachment for high speed production on concrete and bituminous pavements, city streets and highways—32 pages. The Lakewood Engineering Company, Columbus, Ohio.

Graders

77. "Blade Graders" is a 48 page booklet, recently published by the Caterpillar Tractor Co., Peoria, Ill., giving the complete details of "Caterpillar" graders.

78. The No. 101 Austin Leaning Wheel Grader is completely detailed and illustrated in Bulletin No. 1238 which shows operation of Z-Bar, back sopper, bank cutter, etc. Published by The Austin-Western Road Machinery Co., 400 North Michigan Ave., Chicago.

79. Austin No. 77 Dual Drive Motor Graders are completely illustrated and described in Bulletin No. 1239 which also contains construction details, specifications and weights. Austin-Western Road Machinery Co., 400 North Michigan Ave., Chicago.

Hose and Belting

87. Complete information on rubber hose and belting for all types of contracting and road building service. The Government Sales Department of the Goodyear Tire & Rubber Co., Inc., Akron, Ohio.

Joint Filler and Line Marker

88. Bulletin No. G-9 issued by Littleford Bros., 452 E. Pearl St. Cincinnati, Ohio, describes and illustrates their new No. 91 Joint Filler which is used to fill horizontal and center joints with hot asphalt. It can be equipped to apply an asphaltic center line as it fills the center joint. This bulletin also describes the Littleford Traffic Line Marker.

Joint Filling Pot

89. A supplement to Bulletin No. E-5 has been issued by Littleford Bros., 452 E. Pearl St., Cincinnati, Ohio, describing their cone-shaped crack filling pot No. 86-B. The chief feature of this pot is that it is springless—there is no mechanism to get out of order. It is used to fill cracks and joints in concrete pavements and interstices in brick or granite block pavements.

Lanterns and Torches

90. Dietz Lanterns and Road Torches adapted for night traffic warning on any construction work that obstructs the highways. R. E. Dietz Co., 60 Laight St., New York, N. Y.

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Loaders and Unloaders

97. Portable Loaders and Unloaders. Folders: Nos. 1073 and 1074 cover Belt Conveyors with channel iron and truss types of framework; No. 1076, Portable Bucket Elevators for different classes of work; and No. 1149, the "Grizzly" Crawler Loader for heavy work and large capacities. Link-Belt Company, Philadelphia.

100. Materials Handling and Positive Power Transmission Equipment, giving technical data, list prices and illustrations of this machinery. Link-Belt Co., Chicago, Ill. General Catalog No. 500.

Motor Trucks

107. "Operating Records for Motor Trucks" is one of the most complete record books available. It includes the necessary forms and directions for a very accurate and detailed accounting of Motor Truck operations. Dodge Brothers Corp., Detroit, Mich.

108. Four-wheel-drive trucks increase the range of truck operation and are particularly adapted for economy of operation in road building and maintenance. Dept. B, Four Wheel Drive Auto Company, Clintonville, Wisconsin.

Paving Materials

109. A 36-page booklet with 66 illustrations has just been issued by the Barrett Co., giving full information regarding the making, laying and maintaining of "Tarvia-lithic," the ready-to-lay pavement.

111. "Tarvia Double Seal Pavements." Shows, step by step, the construction of a Tarvia pavement. 24 pages. The Barrett Company, 40 Rector Street, New York.

112. Complete directions for surface Cut Back Asphalt are contained in a 36 treatment and bituminous surfacing with page data book. Standard Oil Co. of Indiana, 910 So. Michigan Ave., Chicago, Ill.

Road Construction

122. "**Road Building Machines**" is a handy reference booklet to the complete line of "**Caterpillar**" **road** machinery. 40 pages.

Road Machinery

125. The following publications cover a wide range of valuable and useful information on road-building machinery. Sixty Leaning Wheel Grader, the Super-Special Grader, the Motor Patrols, the Twenty-Planer, the Hi-Way Patrol Grader No. 3, the Ten Motor Patrol, and the Auto Patrol. Caterpillar Tractor Co., Peoria, Ill.

126. A new picture book of the Austin-Western Line of road machinery showing the application of road graders, road rollers, elevating graders, crawler and wheeled wagons, crushing and screening plants, shovels, cranes and excavators, scarifiers and many small tools, is contained in Catalog No. 1247. Copies available on request at The Austin-Western Road Machinery Co., 400 North Michigan Ave., Chicago.

127. "Road Machinery Illustrated." New illustrated bulletins on the motor rollers, three-wheel and tandem rollers, motor graders powered by Caterpillar, Twin City, Cletrac, McCormick-Deering and Fordson tractors, and straight and leaning wheel graders. Galion Iron Works & Mfg. Co., Galion, O.

Elevating Graders

129. An interesting booklet on Elevating Graders has recently been issued by the Caterpillar Tractor Co., Peoria, Ill.

Rollers

131. A 16-page booklet printed in two colors gives full details and specifications of the Erie Roller. Also explains how to use it to save tamping costs. Numerous action pictures. Erie Machine Shops, Erie, Pa.

132. A 32-page book in four colors featuring a complete line of road rollers. 8¾ x 11, leatherette cover, numerous action pictures. Buffalo-Springfield Roller Co. of Springfield, Ohio.

133. 20-page pocket size booklet showing all types of Buffalo-Springfield motor rollers and scarifiers and their uses. The Buffalo-Springfield Roller Company, Springfield, Ohio.

134. "Road Rollers." Illustrated booklets covering the entire line of Master 4-Cylinder motor roller, 4-cylinder tandem roller and International motor roller. Galion Iron Works and Manufacturing Co., Galion, O.

135. 36-page, illustrated book describing the application of Motor Rollers to many types of road construction and maintenance. Huber Mfg. Company, Marion, Ohio.

136. Full description of Huber Motor Rollers in sizes from 5 to 15 tons, included in durable 36-page book for use by road contractors and maintenance crews. Huber Mfg. Co., 345 E. Center St., Marion, Ohio.

Sand and Gravel Buckets

137. The Owen Bucket Company, Cleveland, Ohio, have available illustrated folders on Sand and Gravel Buckets showing the various types, sizes and uses for which they are intended. A complete catalog on all types of Sand and Gravel Buckets will also be furnished on request.

Sand and Gravel Washing Plants

140. Seventy-page catalog giving complete information regarding Sand and Gravel Washing Plants, stationary and portable. Those interested in such equipment should have a copy. Link-Belt Co., Chicago, Ill.

Shovels, Cranes and Excavators

144. Complete information including operating ranges of General Excavators is given in Bulletin No. 3105 recently prepared by The General Excavator Co., 365 Rose St., Marion, Ohio.

145. The Austin Badger, a new, fully convertible ⅜ yard crawler shovel, made by The Austin-Western Road Machinery Co., 400 North Michigan Ave., Chicago, is fully described and illustrated in their Bulletin No. 1236.

146. Link-Belt Co., Chicago, Ill., has issued Book No. 1095, which describes and illustrates their complete line of Gasoline, Electric, or Diesel operated shovels, cranes and draglines.

151. Lifting capacities and working ranges for the different sizes and types of the complete line of ½-yd. to 1½-yd. shovels, cranes, draglines, ditchers and skimmers. Orton Crane & Shovel Co., 608 S. Dearborn St., Chicago, Ill.

Steel Posts

160. Steel Posts for highway guard rails, fences and other purposes. Catalog and data book. Sweet's Steel Company, Williamsport Pa.

Surveying Instruments

163. A complete catalog and instruction book pertaining to the "Sterling" transits and levels are described and illustrated in a 64-page booklet. Warren-Knight Co., 136 No. 12th St., Philadelphia, Pa.

164. Booklet on the most popular types of Transits and Levels in general use by Engineers and Surveyors, giving full information on the sizes and styles of these instruments. Issued by C. L. Berger and Sons, Inc., 37 Williams St., Boston 19, Mass.

Tires, Truck and Tractor

165. Speed and economy in use of solid, cushion and pneumatic tires and tubes for trucks, cars, tractors, graders and other road machinery. Government Sales Department of the Goodyear Tire & Rubber Company, Inc., Akron, Ohio.

Tool Boxes

167. Bulletin No. G-6 issued by Littleford Bros. 452 E. Pearl St., Cincinnati, Ohio, describes and illustrates the Han-DeeBox, a portable tool box of all-steel construction. This tool box is equipped with a special locking device that locks both covers at the same time. No padlocks are used. Littleford trailers, lead melting furnaces, and "Hot Dope" Kettles for pipe coating are also described in this bulletin.

Tractors, Crawler

171. The design, construction, details and complete specifications of the Ten and Fifteen models "Caterpillar" are given in a booklet published by the Caterpillar Tractor Co., Peoria, Ill.

172. The Caterpillar Sixty Tractor. This beautifully illustrated booklet tells the story of the Caterpillar Sixty Tractor design and construction. Caterpillar Tractor Co., Peoria, Ill.

175. Caterpillar Tractors. The "Fifty;" the "Thirty-five;" the "Twenty-five." Full data on these models. Caterpillar Tractor Co. Peoria, Ill.

Road and Street Maintenance

Asphalt Heaters

200. For general construction and maintenance, the Original Improved "Hotstuf" Asphalt Heater, an economical oil burning heater. Mohawk Asphalt Heater Co., 56 Weaver St., Schenectady, N. Y.

201. Full data on tar and asphalt kettles, oil burning kettles, pouring pots, torches and hand spraying attachments. Connery & Company, Inc., of Philadelphia.

205. The latest and improved style "J" Oil Burning Kettle for Paving Contractors, Street and Highway Departments. Connery & Company, Inc., 3900 N. Second St., Philadelphia, Pa.

8. A 32-page general catalog issued by Littleford Bros., 452 E. Pearl St., Cincinnati, Ohio, describes and illustrates their complete road maintenance line, including tar and asphalt kettles, surface heaters, oil burners, sand dryers, tool boxes, lead and compound furnaces, tool heaters, asphalt tools, joint and crack fillers, squeegee carts, etc.

Dust Control

210. "How to Maintain Roads," by the Dow Chemical Company, Midland, Michigan, is a manual dealing thoroughly with dust control, road building and maintenance.

211. "Dust Control," a concise, handy pocket reference on control of dust by use of 3C Calcium Chloride. Illustrated. Issued by the Columbia Products Company, Barberton, Ohio.

Dust Laying

213. Full information regarding the use of Solvay Calcium Chloride for effectively laying dust. The booklet, "Solvay Calcium Chloride, a Natural Dust Layer," 24 pages, 5½x8, covers application, economies, etc. Sent without cost. Solvay Sales Corporation, New York.

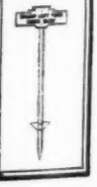
Emulsion Sprayers

214.—A complete line of emulsion sprayers is described in Bulletin No. G-5 recently issued by Littleford Bros., 452 E.

SWEET'S STEEL POSTS

Available in ten standard lengths varying from 5 to 9½ feet in length and in four standard weights.

No separate parts are required to attach fencing — adaptable to any type of wire fencing.



SWEET'S STEEL COMPANY *Write for Descriptive folder.* **Williamsport, Pennsylvania**

New Sanitary Engineering Equipment

New and Improved Equipment for Sewage and Water Treatment. Other New Devices.

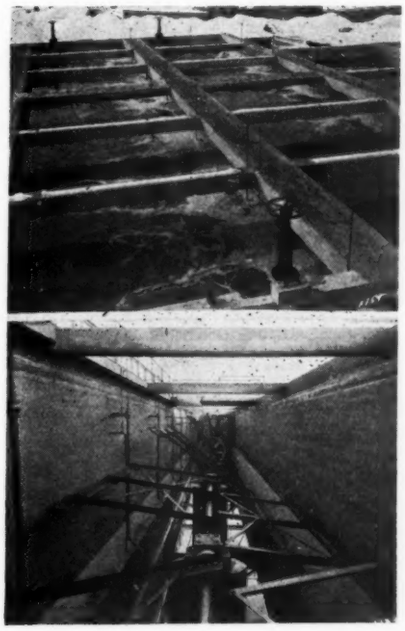
The Dorrco Aerator

The Dorrco Aerator, the latest addition to the Dorr Company's line of sanitary engineering equipment, is being introduced for general aeration work at sewage treatment plants of the activated sludge type. This new aerator is of the combined mechanical and diffused air type, and is distinctive in that the rotary motion of the sewage, induced by the mechanism, operates in a direction counter-current to that of the upward flow set up by the rising bubbles of diffused air.

The Dorrco Aerator is supplied in the simplex, duplex and multiplex types, this designation corresponding to the number of series of motor-driven paddles used for the agitation and circulation of the sewage. In the simplex type, where only one series of paddles is used, the diffused air is admitted through a single row of porous plates, set upon a narrow ledge projecting from one side of the tank a few feet above the bottom. In the duplex and multiplex types, the porous plates are placed upon one or more elevated ridges along the tank bottom and between the paddle shafts so that each row of plates serves the two series of paddles adjacent to it. By driving the paddles downward against —not upward with—the stream of rising air bubbles, the period of contact between air and sewage is increased, the air is distributed across the complete width of the tank and the amount of air required to secure a definite biological result is materially decreased.

The mechanism of the Dorrco Aerator consists of paddle wheel units, attached at regular intervals to a single shaft which passes axially through the tank. The entire mechanism is below the water level and the tips of the paddle blades clear the sides and bottom of the tank and the water surface.

The Dorrco Aerator is arranged for installation in both new tanks and existing ones. It may be supplied in a wide range of diameters corresponding

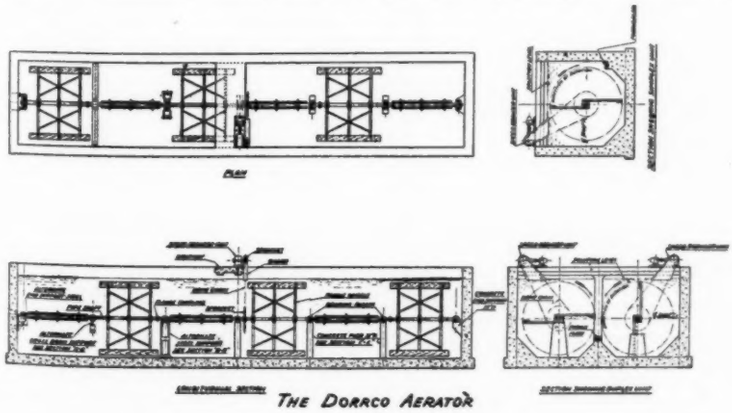


The Dorrco Aerator, in operation above and as installed below.

with various tank sections and due to the sectional type of construction may be built up to any reasonable length, with or without multiple drive units. The approved and most economical duplex type of aerator consists of two series of paddles installed side by side in a concrete tank 24 feet wide, 14 feet deep and 100 feet long, with a single central row of air diffusion plates on an elevated ridge along the long axis of the tank and with the paddles rotating in opposite directions so that the blades of both mechanisms move downward against the stream of rising bubbles at the center. This size of aerator has a rated capacity of 1,000,000 gallons with six hours of contact.

Dorrco Aerators are installed at Escanaba and Muskegon Heights, Mich., and at Phoenix, Ariz. Tests at two of these plants have yielded certain comparative operating data on this aerator and aerators of the conventional straight, diffused air type. Whereas the diffused air type generally requires 0.8 to 1.5 cu. ft. free air per gallon of sewage and 20-35 horsepower input per million gallons, the Dorrco Aerator secures the same biological result, measured by B. O. D. reduction, with 0.3 cu. ft of air per gal. and a total power input (including both air compression and mechanism rotation) of 15-18 horsepower. The power consumed is divided almost equally between compressing the air and revolving the paddles and the economies realized are attributed to the unique and more efficient method of introducing the diffused air counter-current to the swirl imparted by the paddles.

An unusual feature of the Dorrco Aerator is the feasibility of operating it on average domestic sewage without any compressed air whatsoever during the nightly period of minimum load. The rotating paddles prevent the segregation of solids, which otherwise would take place, and furthermore, the sewage received at the plant between 11 P. M. and 7 A. M. is generally so dilute and so reduced in volume that it is easily and safely absorbed by the old and fully aerated sludge in the process of recirculation. No appreciable change in the B. O. D. of the final effluent is caused by this practice and obviously the shutting down completely of the air compressor plant for eight hours a day makes it possible to realize operating economies of an even higher order than mentioned in the foregoing.



THE DORRCO AERATOR

Filclorator

The Filclorator, made by the Filclor Company of Philadelphia, Pa., has been introduced to meet a pressing need in the operation and maintainence of chlorine apparatus. It is particularly applicable to the water works, sewage, and kindred fields where continuous uninterrupted performance is as essential as chlorination itself, since chlorination is primarily a health protective measure. The prime purpose of this ingenious device is to extract malicious elements, or impurities of foreign materials, which by virtue of existing conditions become impurities. When these are allowed to find their way to the chlorinator, they tend to clog the orifices of the control mechanism, and cause a stoppage.

The Filclorator is attached to the outlet of the gas or liquid container. The gas passes through an orifice gauged to meet the required rate of flow, to a pre-expansion chamber, thence to a salicious scrubber and finally, through a filter. By this arrangement all elements that might otherwise deposit in the chlorinator are precipitated and retained.

(*Continued on page 75*)

Pearl St., Cincinnati, Ohio. Littleford Emulsion Sprayers will spray any type of asphalt emulsion used for penetration patch work or curing concrete. They are also used to spray silicate of soda and weed exterminators.

Highway Maintenance

215. "Road and Street Maintenance Equipment," a compact vest pocket manual containing illustrations and brief descriptions of their extensive line. Littleford Bros., 452 East Pearl St., Cincinnati, Ohio.

216. "Light and Heavy Road Maintenance" describes fully the FWD truck and its economy for use in pulling road graders and maintainers—issued by Dept. B, Four Wheel Drive Auto Company, Clintonville, Wisconsin.

218. "Maintenance Machines," a 32 page booklet, tells of "Caterpillar's" complete line of maintenance machines—3 sizes of motor patrols, a trailer patrol and planer—including machines to fit all pocketbooks and all road maintenance conditions. Caterpillar Tractor Co., Peoria, Ill.

Highway Maintenance

219. "Tarmac C P (Cold Patch)." Valuable information concerning the varied uses and methods of application of cold mix for repairs and surfacing, together with many actual photographs. Koppers Products Company, Koppers Building, Pittsburgh, Pa.

Surface Heaters

225. The "Hotstuf" three in one, combination Tool, Asphalt and Surface heater is described and its use illustrated in Bulletin 16. Mohawk Asphalt Heater Co., 56 Weaver St., Schenectady, N. Y.

Road and Paving Materials

Bituminous Materials

226. "Mixed - in - Place Construction." Step-by-step pictures and specifications for constructing road surfaces by Retread or Turnover methods. Koppers Products Co., (Tarmac) Koppers Bldg., Pittsburgh, Pa.

227. "Asphalt for Every Purpose," a 44-page illustrated booklet describing Stanolind Asphalt products. Standard Oil Co. of Indiana, 910 So. Michigan Ave., Chicago, Ill.

228. A new booklet has just been issued by The Barrett Co., 40 Rector St., New York, describing and illustrating the uses of each grade of Tarvia and Tarvialithic. 32 excellent illustrations.

Brick, Paving

230. Full information and data regarding the use of vitrified brick as a paving material, cost, method of laying, life, etc. National Paving Brick Manufacturers' Association, National Press Building, Washington, D. C.

Concrete Curing

235. "How to Cure Concrete," is a manual of instruction on the curing of concrete pavements. 47 pages. The Dow Chemical Company, Midland, Mich.

Maintenance Materials and Methods

270. "How to Maintain Roads," by the Dow Chemical Company, Midland, Michigan, is a manual dealing thoroughly with road building, maintenance and dust control.

275. "Tarvia-K. P. for Cold Patching." An instructive booklet illustrating and describing each step in patching a road wth "Tarvia-K. P." 16 pages, illustrated, 3½x9. The Barrett Company, New York.

276. "Road Maintenance with Tarvia." A 56-page illustrated booklet of value to every road man. Shows how almost every type of road and pavement can be repaired and maintained with Tarvia. The Barrett Company, New York.

277. "Surfacing with Tarmac." A concise booklet describing methods and advantages of using Tarmac in prime coating, surface treatments, re-treatment, penetration, mixed-in-place, etc. Koppers Products Company, Koppers Building, Pittsburgh, Pa.

Snow Removal

Snow Removal

348. "Winter Maintenance" is the title of a booklet which illustrates many types o fsnow plows and methods of handling snow removal problems. Dept. B, Four Wheel Drive Auto Company, Clintonville, Wisconsin.

349. "The Answer to the Snow Removal Problem." It gives full details of the Frink type S snow plow for trucks. Carl Frink, Mfr. of Clayton, N. Y.

354. "Snow Removal Equipment" pictures various types of snow-fighting equipment built for "Caterpillar" Tractors are pictured in relief and in action. Caterpillar Tractor Co., Peoria, Ill.

355. "Conquering Snow With Caterpillars." "An Unwelcome Visitor Is Coming." "A Wall Ten Miles High." Three publications on the snow problem by the Caterpillar Tractor Co., Peoria, Ill.

358. Complete data for selecting the proper size snow plow for your particular make and model of truck. Carl H. Frink, Clayton, N. Y.

359. Galion Iron Works and Mfg. Co., Galion, Ohio. Details, prices and catalogs of their snow plows adaptable to any make of truck.

Sanitary Engineering

Activation and Aeration

390. A booklet of value to sanitary and chemical engineers describes Norton Porous Mediums of bonded fused alumina (strong chemically stable, uniformly permeable) and their use in aeration of water and sewage. Norton Co., Worcester, Mass.

Glass-Overs

392. Full details regarding the use of Lord & Burnham Glass-Covers at Dayton, Ohio; Highland Park, Ill.; Fostoria, Ohio; and Bloomington, Ill. are given in bulletins Nos. 10, 11, 14, 15. Issued by Lord & Burnham, Graybar Bldg., New York, N. Y.

Incinerators

396. "Pittsburgh-Des Moines Incinerator," built and guaranteed by the Pittsburgh-Des Moines Steel Company, 3479 Neville Island, Pittsburgh, Pa. Booklet on request.

Jointing Materials

401. G-K Compound for vitrified clay sewers, MINERALEAD for bell and spigot water mains, also M-D Cut-Ins for making house connections. Atlas Mineral Products Company, Mertztown, Pennsylvania.

402. Full details concerning No. 1 Korite for sealing sewer pipe joints so that they will be permanently tight. Standard Oil Co. of Indiana, 910 So. Michigan Ave., Chicago, Ill.

403. An illustrated folder has just been issued by the Cochrane Chemical Co., 432 Danforth St., Jersey City, N. J., detailing the advantages and the savings in the use of Ex-XL-cell Sewer Pipe Joint Compound.

Manhole Covers and Inlets

404. Street, sewer and water castings made of wear-resisting chilled iron in various styles, sizes and weights. Manhole covers, water meter covers, adjustable curb inlets, gutter crossing plates, valve and lamphole covers, ventilators, etc. Described in catalog issued by South Bend Foundry Co., South Bend, Ind.

Pipe, Cast Iron

406. "Data Book"—Cast Iron Pipe and Fittings, sizes 1¼ through 12 inches, either with or without Precaulked lead joints factory-made in the bells. The McWane Cast Iron Pipe Co., Birmingham, Ala., and Provo, Utah.

407. New "Handbook of deLavaud Centrifugally Cast Iron Pipe" contains useful information for the water works man including revised specifications together with dimensions and weights of deLavaud pipe in accordance with Federal Specifications for Pipe; Water, Cast-Iron (Bell and Spigot) N. WW-P-421. Just issued by the U. S. Pipe and Foundry Co., Burlington, N. J.

Pipe Line Construction

410. Pipe Lines and the Caterpillar. In this 32-page booklet are pictured many uses of the Caterpillar Tractor, and ways in which they can be applied to the saving of men, money and minutes. The Caterpillar Tractor Co., Peoria, Ill.

Pumping Engines

413. "When Power Is Down," gives recommendations of models for standby services for all power requirements. Sterling Engine Company, Buffalo, N. Y.

Pumps, Centrifugal

415. Design data for centrifugal pumps for high or low service pumping for waterworks and filtration plants. Dayton-Dowd Co. Mfrs. Centrifugal Pumps, Quincy, Ill.

Pumps—Sewage

417. Non-clog vertical and horizontal sewage pumps and their characteristics are described and illustrated in bulletins of the Dayton-Dowd Co., Quincy, Ill.

Screens, Sewage

418. Sewage screens (Tark, Brunotte, and Straightline) for fine and coarse sewage; Straightline Collectors for Settling Tanks (Sludge, Scum and Grit), and Mechanical Aerators for activated sludge plants. Link Belt Company, 910 So. Michigan Ave., Chicago, Ill. Book 642.

Screens

420. Water Screen Book No. 1252, describes water screens and gives complete technical information about them. Link-Belt Co., Chicago, Ill.

Sludge Bed Glass Covers

425. Folder, standard filling size, contains model set of specifications and 11 x 17 inch drawings showing standard sizes and construction details of King Glass Enclosures for sewage treatment plants. King Construction Co., 539 Wheatfield St., North Tonawanda, N. Y.

426. Sludge Bed Glass Covers—"Super-Frame" Hitchings & Co., Main Office, Elizabeth, New Jersey. Offer A. I. A. File 101SB, describing glass covers for sludge and sprinkler beds; details, specifications and cost data.

427. Bulletin GE31 describes Glass Enclosures for Sludge Beds in detail. Specifications, cross sections, details and illustrations shown are of value to engineers and officials. Sent promptly upon request. American-Moninger Greenhouse Mfg. Corp., Dept. B, 1947 Flushing Ave., Brooklyn, N. Y.

Sewer Maintenance

428. "The Expanding Root Cutter and Sewer Cleaning Method," a 32-page booklet prepared by the Expanding Sewer Machine Co., Nappanee, Ind., gives full details as to methods and equipment needed for sewer cleaning.

Sludge Treatment

430. Downes Floating Covers and Sludge Digestion Equipment. The Pacific Flush Tank Co., 136 Liberty St., New York, N. Y. Contains photographs of installations of floating covers and technical data on the subject.

Treatment

432. Eight separate catalogs on Sewer and Sewage Disposal Automatic Equipment, including pumps, Imhoff Tanks and Sewer Joint Compounds. The Pacific Flush Tank Company of Chicago and New York.

433. Collectors and concentrators for modern sewage treatment plants, recent installations, and full data on aerators, and screens. Link Belt Co., 910 So. Michigan Ave., Chicago, Ill. and Philadelphia.

Valves

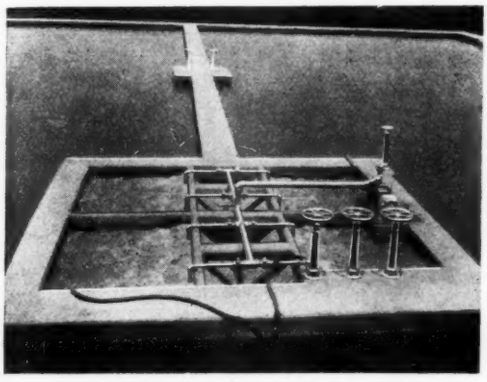
436. Data Book on Bronze and Iron Valves for service on Steam, Water, Gas, Gasoline, Air and Oil lines. The Fairbanks Company, 393 Lafayette Street, New York, N. Y.

Water Development

440. Complete details of the Layne System of water development for municipalities and irrigation projects, based on deep wells and turbine pumps. Layne & Bowler, Memphis, Tenn.

New Link-Belt Sewage and Water Treatment Equipment

The sewage and water treatment equipment division of Link-Belt Company, Philadelphia, Chicago, San Francisco, announces the recent addition of three distinctly new, yet tried and proved, units to its line of sewage and water treatment plant machinery. They are (1) the Link-Belt Elevated Diffuser Aerator-Mixer; (2) the Type "C" Straightline Screen—a combined screen and grit chamber, and (3) the Mieder Collector for removing sludge from primary settling tanks.



Link-Belt Elevated Diffuser Aerator-Mixer.

Aerator-Mixer.—This mixer, on which patents are pending, is of the elevated diffuser type, using air for agitation. Rectangular tanks of a maximum width of 16 feet, a maximum depth of 12 feet, and with a detention period of approximately one-quarter hour, are required. The elevated diffusers are located at one side of the tank. Approximately 50 cubic feet of free air per minute per million gallons is required. The power consumption is about .05 KW. The velocity is regulated by valves which regulate the flow of air to the different tubes. There is practically no loss of head, and there are no dead spaces in the mixing chambers. Alum and lime may be introduced at different parts of the mixer.

Type "C" Screen.—The Link-Belt Straightline type "C" Screen, on which patents are pending, is a combined bar screen and grit chamber, especially designed for use at medium and small size plants, where the cost of separate mechanically cleaned units might be prohibitive. It is adapted for continuous or intermittent operation.

Its main elements consist of a hopper, a bar screen with approximately 1 inch openings, and a bucket elevator for the dual service of removing the grit from the hopper, and cleaning the bar screen.

Regulation of the currents through the hopper, is made by two baffle plates near the influent end, one adjustable downward and the other upward, to permit settling of the grit, and prevent settling of the organic matter. The upper baffle allows part of the flow to pass over it.

The lips of the elevator buckets are provided with rake teeth, which engage with and clean the screen bars on their downward travel. The buckets are perforated, permitting the water to drain out while they carry the grit and other accumulations up to discharge into a suitable container or trough for removal.

Mieder Collector.—Link-Belt has acquired the patent rights for the sale and construction in the United States, of the Mieder Collector for the removal of sludge from primary settling tanks. This is a machine that has proved its worth in German plants.

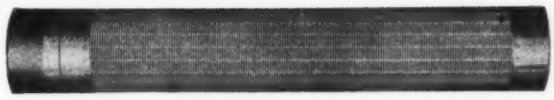
Link-Belt Mieder Collector for removing sludge from primary settling tanks.

The Mieder Collector consists of a traveling bridge to which is hinged a deep scraper. This scraper moves the sludge, which has settled on the bottom of the tank, towards the influent end, where it is withdrawn. On the return run the scraper is raised to the position shown in illustration, and used for skimming the surface of the liquid in the tank.

One collector can serve a large plant, because it can be transferred from one tank to another. At Leipzig, Germany, one machine serves four tanks, each approximately 40 feet wide, and varying in length from 160 to 200 feet.

All of the driving machinery is located on the bridge, out of the sewage, and the scraper can be inspected whenever it is raised to the surface. The machine is operated by one man, and combines large capacity with low-cost operation.

The Johnson Well Screen

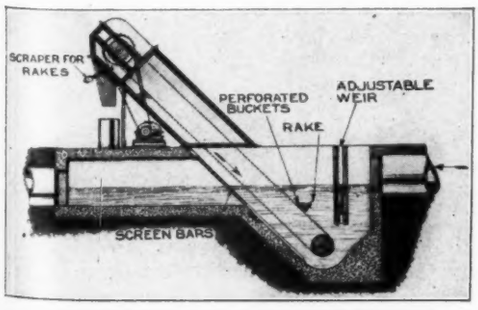


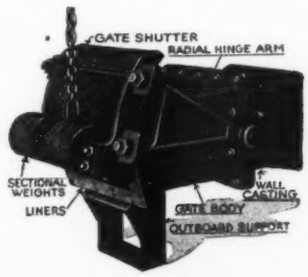
New Johnson Well Screen

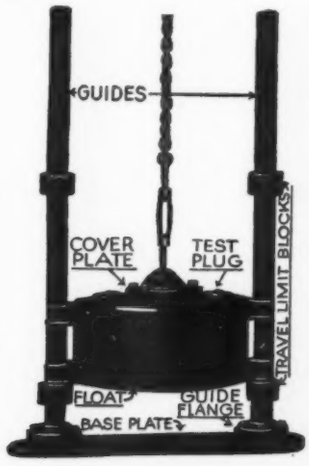
Edward E. Johnson Co., Inc., St. Paul, Minn., have announced a new well screen. The four outstanding features are: (1) Constructed entirely of one metal with a choice between several different kinds of metal to meet the exact requirements of each well; (2) Welded by a method which maintains almost the entire strength of the original parts and builds the screen as one unit of great strength without solder or locked joints; (3) Large area of intake opening; (4) Sharp outer slot which widens toward the inside and has direct opening into the screen.

Regulators for Hydraulic Control

Automatic regulators for such purposes as the diversion of flow from sewers, when the volume of flow reaches a predetermined amount; and for the control of flow of water from one basin or reservoir to another, are manufactured by Brown & Brown, Lima, O. These regulators are available in twelve sizes, from 12x12 inches to 28x59.75 inches, the latter having an area of 11.64 sq. ft. under a 6.0-ft. head, the discharge of this gate is 217.44 cfs. Graphs of discharge for design are available on request. These apply to both circular and egg-shaped sewers. Masonry structures for these regulators are very simple.







Above: Brown and Brown regulator and, right, float control. Left, the Link-Belt Type "C" straightline screen.

Water Storage

442. "Modern Water Storage" contains 28 pages of reliable information, interesting photographs, authentic engineering data and "Pittsburgh-Des Moines" specifications on various types of elevated tanks, penstocks, pipe lines, stand pipes, steel reservoirs, treating plants and complete water systems.

Miscellaneous

Airport Construction

595. Airports and Airways. A 20-page illustrated booklet by the Caterpillar Tractor Co., Peoria, Ill., describes the uses of tractors in building airports and handling planes.

597. "Getting on the Air Map With 'Caterpillar,'" describes the many uses of the tractor in building and maintaining airports better, quicker, cheaper. Caterpillar Traction Co., Peoria, Ill.

Chains and Speed Reducers

607. Link-Belt Co., 910 So. Michigan Ave., Chicago, Ill., gives full description of its positive drives in books No. 125, Silent Chain; No. 1257, Roller Chain; No. 815, Herringbone Speed Reducers; No. 1050, Promal Chains. Send for these positive power transmission books.

Community Advertising

610. Booklet showing various forms of publicity matter useful in arousing interest in the construction of small town water supplies. This matter is furnished free to Consulting Engineers and towns interested in waterworks construction by The Cast Iron Pipe Research Association, 566 Peoples Gas Bldg., Chicago, Ill.

Rules

625. The Lufkin Rule Company, Saginaw, Mich.; New York; Windsor, Canada. Manufacturers of Measuring Tapes, Boxwood Rules, Spring Joint Rules, Straight and Folding Steel Rules, Fine Mechanics Tools and Aluminum Folding Rules, General Catalog No. 11.

Transits and Levels

629. A booklet giving full information on the sizes and styles of Berger Transits and Levels will be sent promptly by C. L. Berger & Sons, Inc., 37 Williams St., Boston 19, Mass.

630. Transits and Levels particularly adapted for City, County and State work are described in a 64-page catalog. Warren-Knight Co. 136 No. 12th St. Philadelphia, Pa.

LATEST PUBLICATIONS

Following are among the latest publications received and have not been described in this section before.

Graders

76. Latest information about Gallon Motor Patrol Graders, Road Maintainers and Leaning Wheel Graders is contained in a new series of illustrated catalogs, Nos. 125, 130, 135 just issued by the Gallon Iron Works & Mfg. Co., c-o The Jeffrey Mfg. Co., Columbus, Ohio.

723. *Conversion Factors.*—A compendium of useful data for the rapid conversion of the common engineernig units of measure of one system into the different but related units of another system. Just issued by the Dorr Co., 247 Park Ave., New York City.

724. *Hardinge Clarifiers.*—Hardinge Co., York, Pa., have recently issued a booklet illustrating and describing their clarifiers, both for rectangular and circular tanks. This 12-page booklet is both interesting and valuable.

725. *Swimming Pools.*—Two interesting folders on swimming pools have been published by the Portland Cement Association. The first one tells "How Can We Get A Swimming Pool." It describes a number of methods or organizing a public interest campaign. The other folder shows how various municipalities have financed their pools, and suggests plans for use in raising construction funds.

726. *Ready-Mixed Concrete in 20 Plants.*—The Chain Belt Co., Milwaukee, Wisc., recently completed a survey of 20 average central mixing plants to determine costs and prices. They have published the information secured by the survey in a 16-page booklet which tells facts without reference to advertising. It will be sent on request.

727. *Industrial Lubricants.*—Beginning in April, the Standard Oil Co. (Indiana) will publish each month a technical monograph on the lubrication of some type of equipment. The discussion will be simple, brief and informative. Address the technical division, 910 S. Michigan Ave., Chicago, Ill., or PUBLIC WORKS.

728. *⅜-Yard Shovel.*—Bay City Shovels, Bay City, Mich., have published catalog B-1, describing in detail their new model B, ⅜-yard shovel, clamshell, dragline, trench hoe and 5-ton crane.

729. *¼- and ½-Yard Excavators.*—Hanson Excavators in three sizes, ¼, ⅜ and ½-cubic yards capacities, and the types of work they will do as shovel, dragline, clamshell, skimmer, trench-hoe and crane are described in a 12-page bulletin.

730. *Shoulder Finishing Machine.*—An improved Moritz Shoulder Finishing Machine, of the type used by contractors and highway departments in more than 20 states, is described in a bulletin issued by the Moritz-Bennett Corp., Effingham, Ill.

731. *Wire Rope.*—Williamsport Wire Rope Co., Chicago, Ill., has issued a folder illustrating their new method of "preseating."

732. *Street Markers.* — Non-corrosive bright metal markers for streets are fully described in a 4-page publication by the Edwards Mfg. Co., Eggleston Ave., Cincinnati, O. Made from pure zinc or brass.

733. One of the most complete bulletins (47F) covering the application of the Finishing Machine to concrete highways and streets has just been prepared by the Lakewood Engineering Co., Columbus, Ohio., 26 pages, 57 illustrations.

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When you want catalogs describing materials or equipment advertised in PUBLIC WORKS, refer to the classified INDUSTRIAL LITERATURE section beginning on page 71 and order by number.

Printed by WNU, New York